The

Encyclopedia of Practical Horticulture

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The

Encyclopedia of Practical Horticulture

A Reference System of Commercial Horticulture

Covering the Practical and Scientific Phases of Horticulture with Special Reference to Fruits and Vegetables

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Assisted by the best known scientific and practical horticulturists throughout the country, and particularly in the Northwest . . .

Illustrated

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Maryland

Maryland has an area of 12,210 square miles, or 7,814,400 acres. Of this area 2,350 square miles is water. It is divided into two parts by the Chesapeake bay, which extends north almost to the northern boundary of the state, leaving the larger body of land on the western side of the bay. The drainage system of the state is mostly toward the Chesapeake bay. This bay is navigable along its whole length and has some good harbors. The principal rivers are the Potomac, navigable for 1,125 miles; the Monocacy, Gunpowder, Patuxent, South Severn, Patapsco, Bush, Susquehanna, Wicomico, Pocomoke, Manokin, Nanticoke, Choptank, St. Michaels, Wye, Chester, Sassafras, Elk. Some of these rivers might more properly be called sounds along the Atlantic coast, or estuaries along the Chesapeake bay.

The climate of Maryland is mild, the mean annual temperature being 54 degrees to 64 degrees, and the mercury in winter seldom falls below zero. The temperature both in summer and winter is modified by its proximity to the ocean and the Chesapeake and Delaware bays.

The soil, for the most part, is a light loam favorable for the production of almost all kinds of fruits and vegetables. However, the production of winter apples is not a large industry as compared with that of some of the Northern states; but peaches, pears, plums, berries and vegetables are among the important industries of the state.

Maryland is most favorably situated in relation to the markets. Its coast line, bays, rivers and harbors penetrating the state at so many points furnish cheap transportation to the markets of the large cities, such as Baltimore, Philadelphia, New York and the New England cities, before the products of the North are ready for shipment. This fact has caused the growing of vegetables to become very profitable and has been the basis for the development of a very large canning industry.

The growing of peaches has assumed enormous proportions. At one time it seemed that this industry, on account of insect pests and fungous diseases, would be abandoned, but by the aid of state and government experiments the growers have learned to successfully protect their trees and to adapt varieties to the conditions under which these fruits must be grown, and they are now succeeding.

The number of bearing apple trees reported in 1910 was 1,288,482; peach trees, 1,497,724; pears, 540,583; plums and prunes, 69,996; cherries, 82,305; grapes, 138,801 vines. Small fruits, 16,595 acres; nuts, 11,780 trees.

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Fruit Production in Maryland

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total		16,595	17,522	26,277,054	$1,227,548
Strawberries	7,468	14,292	13,980	23,611,095	1,070,072
Blackberries and dewberries	979	1,180	1,501	1,372,164	68,817
Raspberries and loganberries	1,333	846	1,385	959,369	67,516
Currants	366	36	65	34,009	3,138
Gooseberries	365	241	234	300,321	18,000
Other berries	1	(1)	357	96	5

1 Less than 1 acre.

Strawberries are by far the most important of the small fruits raised in Maryland, with blackberries and dewberries ranking next. The total acreage of small fruits in 1909 was 16,595, and in 1899, 17,522, a decrease of 5.3 per cent. The production in 1909 was 26,277,000 quarts, as compared with 27,958,000

quarts in 1899, and the value was $1,228,-000 in 1909, as compared with $1,181,000 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts, and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	.....	3,501,774	....	1,671,435	2,577,359	$1,517,400	3,710,666
Apples	34,798	1,288,482	17,157	660,685	1,822,824	902,077	3,150,673
Peaches and nectarines	14,464	1,497,724	9,027	805,063	324,609	361,617	172,303
Pears	23,199	540,583	7,893	138,152	367,359	168,561	301,702
Plums and prunes	10,436	69,996	4,398	29,478	13,526	16,192	19,945
Cherries	14,002	82,305	4,613	27,774	42,315	60,121	60,452
Apricots	998	1,747	470	1,127	365	448	313
Quinces	5,853	20,936	2,288	9,145	6,359	8,383	(2)
Mulberries	1	1	2	11	2	1	(2)
Unclassified	....	....	....	....	....	....	[3] 5,278
Grapes...	11,718	138,801	2,328	44,690	2,152,382	53,498	1,685,900
Nuts, total	.....	[4] 11,780	....	[4] 4,227	[4] 318,148	[4] 5,687	65,950
Persian or English walnuts	754	2,068	444	1,758	6,916	745	50
Pecans	339	172	63	460	1,717	85	50
Black walnuts	1,010	5,375	101	1,522	274,936	2,997	(2)
Chestnuts	91	3,579	16	154	24,842	1,439	(2)
Unclassified	....	....	....	....	....	....	[3] 65,850
Tropical Fruits, total....	....	[5] 1,433	....	713	....	[5] 1,393	....
Figs	245	1,432	74	713	38,772	1,388	100

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of all products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes almonds, Japanese walnuts, Japanese chestnuts, hickory nuts, butternuts, chinquapins, filberts and hazelnuts.
[5] Includes Japanese persimmons.

The total quantity of orchard fruits produced in 1909 was 2,577,000 bushels, valued at $1,517,000. Apples contributed nearly three-fourths of this quantity, pears and peaches and nectarines most of the remainder. The production of grapes in 1909 amounted to 2,152,382 pounds, valued at $53,498, and the production of nuts to 318,148 pounds, valued at $5,687.

The production of all orchard fruits together in 1909 was 30.5 per cent less in quantity than that in 1899, while the production of grapes increased materially. The value of orchard fruits, however, increased from $1,266,000 in 1899 to $1,517,-000 in 1909, and that of grapes from $43,-282 in 1899 to $53,498 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values for 1909 relate only to the products in their original condition.

Massachusetts

The east and southeast portions of Massachusetts are mainly undulating or level, the central portion is hilly and broken and the west is rugged and mountainous. There are two distinct mountain ranges called the Taconic and the Hoosac, parts of the Appalachian mountain system. The highest elevation in the Taconic range is Mount Greylock, 3,535 feet. The highest peak in the Hoosac range is Spruce Hill, 2,588 feet. The principal rivers are the Hoosac, Connecticut and the Merrimac.

The temperature is subject to extreme fluctuations from very warm in summer to very cold in winter, although near the ocean this is modified to considerable degree. The average rainfall for the state is about 48 inches.

The soil in the eastern and southeastern portions is sandy and requires considerable fertilization to make it productive.

The apple forms about nine-tenths of all the fruit products, and according to the census of 1910 the report of trees of bearing age was as follows: Apples, 1,367,397; peaches and nectarines, 154,592; pears, 113,365; plums and prunes, 41,345; cherries, 13,396; apricots, 654; quinces, 7,484; grapes (vines), 58,277.

Except cranberries and strawberries, the small fruits are unimportant. In 1910 there were reported of cranberries, 6,577 acres, and strawberries, 2,015 acres.

There were 6,720 acres of nuts, mostly black walnuts, butternuts and hickory nuts about equally proportioned.

The largest area of fertile land in Massachusetts is in the Connecticut valley, but besides this there are several small areas of rich soils where all the hardier fruits could be grown for the home markets. The counties having the largest number of bearing apple trees are Worcester, 331,460, and Middlesex, 293,812.

Varieties of Apples for Massachusetts Orchards

Arranged in approximately the order of their ripening, the list which I propose to discuss is as follows, arranged as nearly as may be in the order of their commercial value: Baldwin, McIntosh, Rhode Island Greening, Wealthy, Hubbardston, Williams, Oldenburg, Roxbury, Red Astrachan, Sutton, Gravenstein, Fall Pippin, Westfield, Spy, Yellow Transparent, Blue Pearmain.

As a general principle, we may say that markets are of two types, and that a very different list of varieties would be selected for these two types.

There is first the general or wholesale market, where the apples are handled in large quantities, and where the producer never comes in touch with the consumer. The orchardist growing for this market perhaps sells his fruit to a buyer in the orchard, or loaded on the car, or he may ship it to a commission man. In any case, it is very much to his advantage to have a large quantity of fruit of each variety. If he has 500 barrels of Baldwins, buyers are going to hunt him up and bid for his fruit; whereas, if his 500 barrels are distributed among the 16 sorts mentioned above, there would not be enough of any one kind to interest the buyer. And this same general consideration would hold in any type of general market. If he is shipping to a commission man, 100 barrels each of five sorts will sell for more than five barrels each of 100 sorts. As a rule, a man chooses this type of market if he is some distance from his market. If he is going to plant an orchard to cater to such a trade, he ought, in my opinion, to select not over five, and preferably about three, varieties. A less number than this does not provide for cross-pollination, and does not allow for the years when certain of his varieties will not bear.

The second type of market is the special or personal market. Here the producer comes in direct or nearly direct communication with the consumer—that is, he either peddles his fruit or at most sells it to the man who sells it direct to the consumer. The grower perhaps runs a wagon of his own, or, if he does not do this, he sells to a grocery or fruit store which sells to the consumer. In either case he is so near the consumer that he gets the benefit of the good quality of his fruit or the blame for its bad quality. He gets personal customers who may say: "Yes, Mr. Jones, those apples we got last week were fine. I want some more like them." Or, if the grocer, "When are you going to have some more of Mr. Jones's apples?" In either case, Jones wants to be in a position to supply the demand; in other words, he does not want to work up a market for his Yellow Transparents and then drop it when Williams Early are in season and allow his customers to forget all about Jones before his McIntoshes come on.

But whichever market one is working for there are certain characters in fruit

and tree which ought to be considered, though their relative importance will vary somewhat.

(1) Baldwin

The Baldwin is a chance seedling which was found at Wilmington, near Lowell, Mass. The tree is a strong grower, long-lived and vigorous, making a round-headed top of excellent shape, and is in most respects an ideal tree. It is hardy except in very severe climates. It does not come into bearing early, ranking about with the Gravenstein in this respect. As a rule seven or eight years are required under even good conditions to bring it into profitable bearing. The tree is somewhat subject to canker, though not very seriously so. It bears very abundantly in alternate years and little or nothing in the odd years. Whether this tendency can be overcome by thinning or by some other treatment remains to be settled. The fruit is finely colored when well grown, of good size, regular in form and runs as a rule very uniform, with comparatively few culls. It keeps well, the season being from November to March in ordinary storage, and it stands handling very well indeed. The quality is usually ranked from good to above, when well grown, but a poorly grown Baldwin is a poor thing. This point I think needs decided emphasis, as some of our well-grown Baldwins are the equal in color and attractiveness of anything grown in the famous Northwest. The Baldwin is undoubtedly the most popular and profitable apple in New England and New York. A point worth considering is that it is one of the best export apples, particularly to England, where American-grown Baldwins stand very high.

(2) McIntosh

Perhaps no other apple is more popular at the present time or more largely planted than the McIntosh. It belongs to the Fameuse group, having originated in Ontario, Canada. The tree is a strong grower, hardy and healthy, one of the finest that I know. The side branches come out at almost right angles so that the tree will bear an immense load of fruit without breaking down; the branches are well distributed, and, altogether, it forms a beautiful tree. It comes into bearing relatively early and bears well, though not overabundantly. It has a strong inclination to be an annual bearer when well cared for, which I consider a decidedly important point. The fruit itself is very attractive in appearance, being a bright, handsome red, with a waxy texture to the flesh, which is white, tender and very highly perfumed. The aroma of a good McIntosh is something to be remembered. Its season is from the first of September to perhaps the middle of November in ordinary storage, but it will keep in fairly good condition much longer than this. It is particularly good for holding its color and attractive appearance. It is not an uncommon thing to find good specimens of McIntosh as late as January or February, which, though they have lost something of their quality, are still very good eating. The fruit ripens unevenly and has a considerable tendency to drop, so that picking should be done twice and perhaps three times. It is a very desirable variety for local or special trade, but will not stand rough handling. At present it is probably the most popular variety in Massachusetts.

(3) Rhode Island Greening

The Rhode Island Greening is thought to have originated in the state whose name it bears, and probably near Newport, although the records are not very definite. It would certainly stand next to the Baldwin as a commercial apple in New England, though the McIntosh is undoubtedly far ahead of it in the number of trees being planted at the present time. I believe, however, that the Rhode Island Greening deserves more attention than it is receiving at present from those who are planting commercial orchards. The tree is reasonably hardy, winter-killing only in rather severe climates; it is long-lived and generally healthy, though it does not come into bearing early. Probably eight or nine years would be the usual time required to bring it into bearing. The tree is strong and vigorous, and, as already noted, healthy, although the fruit and foliage are both liable to scab

and in some sections the apple canker attacks it. The form of the tree is decidedly drooping and for this reason it might be headed somewhat higher than the varieties of more upright growth. Its season is a little earlier than that of the Baldwin and it is a good companion variety to plant with the Baldwin in commercial orchards. The fruit is a bright, handsome green in color in the autumn and early winter, but changes to a yellow color later in the season. It is undoubtedly one of the best cooking apples grown. It is more nearly an annual bearer than the Baldwin, though not strictly annual, and the fruit hangs very well on the tree. The season is from late October until March, though varying somewhat with the culture and storage conditions; but it ripens very rapidly when subjected to heat and is very liable to scald in storage, particularly with large, overgrown specimens.

(4) Wealthy

This variety was originated by Peter Gideon, of Minnesota, from seed of the Cherry Crab. The tree is very hardy indeed and a good, thrifty grower while young; but as the trees get older the rate of growth becomes more moderate until when they reach middle age the growth is very slow, and careful cultural treatment is often required to keep up its rate of growth. The tree never reaches large size and for that reason and others is very useful as a filler. It comes into bearing very early. Frequently fruit will be found on the tree in two or three years, though of course only scattering specimens. The fruit is of good quality and finely colored, being a light straw-yellow, splashed and striped and sometimes almost covered with a handsome crimson. It attains good size on younger trees, but on older trees, where, as noted above, growth has become slow, the fruit is apt to run small. This has to be overcome by severe pruning and high fertilizing. The fruit also needs to be thinned to get the best results. In any case the fruit runs very uniform both in size and shape, and for that reason it makes an excellent variety for boxing. The flesh is tender and juicy and requires careful handling in order not to injure it. The season is September and October, slightly before the McIntosh; but it can be kept until December in good storage. The fruit drops badly from the tree and the trees should be picked over two or three times. It is at present being quite largely planted, more so than many other varieties; but, as already noted, its special field is as a filler.

(5) Hubbardston

This is another variety which originated in Massachusetts, having been found at Hubbardston, Massachusetts, very early in the history of the state. The tree is vigorous, particularly when young, and comes into bearing early, frequently giving a fair scattering of fruit from the orchard at four years. The tree is only moderate in size, but bears heavily, at least biennially and sometimes annually; it is therefore a good variety to be used as a filler. It is apt to overbear in a productive year, and for this reason should receive careful attention, to keep the soil in a good state of fertility and the foliage free from fungous diseases or insects. It will often be necessary, also, to thin the fruit, in order to keep it up to the proper size. The tree is considerably subject to canker where that disease is prevalent, and the fruit to the railroad worm. The fruit is of excellent quality, being firm, fine-grained and rich, and when well grown it is finely colored, with handsome appearance and attractive texture, which makes it sell well. As a cooking apple it does not rank so high and ought to be used fairly early, as after it has become more mild it is not nearly as good for this purpose as when it has more acidity. The fruit is uniform and of fair to good size, except when it overbears. Its commercial limit in ordinary storage would be December, and, as with many other varieties, the large-sized, poorly colored specimens do not keep as well as smaller, firmer and better-colored ones. When this variety is well grown it has proved a profitable market sort, standing at present close behind the Greening, and I should have no hesitation in setting it as a market

variety, particularly on light soil, where it does especially well.

(6) Williams Early

This is another of our Masaschusetts apples, and like a great many things which Massachusetts has done, this is a good job. It originated in Roxbury, Massachusetts, more than one hundred and fifty years ago, and in my opinion is one of the best and most profitable of the early varieties. The tree is rather a poor grower and is therefore often best top-worked on some better-growing variety, as Pewaukee or Spy. It is a fairly good cropper and has a decided tendency to be an annual bearer when it receives the right treatment. The fruit is only medium in size, but a beautiful bright red, with a fine though mild flavor. Its strong point is for dessert, but, contrary to the opinion of some others, I consider it a very fine cooking apple. The fruit ripens unevenly, so that it needs more than one picking, and as it is tender both in skin and flesh it ought to be handled with care and packed in boxes. It is a prime favorite in the Boston market and I should not hesitate to plant it as a commercial variety.

(7) Oldenburg

This is one of the Russian varieties which has "made good" in America. It is especially valuable where extreme hardiness is required, but I believe it is worthy of a place in our list of commercial varieties for Massachusetts. As suggested, the tree is very hardy, but is of only moderate size. It grows vigorously while young. Its most valuable characteristic, however, is its early bearing. Fruit is frequently borne on trees at three and four years, and fairly good crops are often borne at four and five years. It is also a reliable cropper, often yielding annual crops, and the fruit hangs well to the tree. The foliage is fine and healthy, and altogether it is a fine tree for a filler, where this system of planting is used. The fruit is of good size and very attractive, being a fine light yellow, with stripes and splashes of handsome red. It runs very uniform on the tree, with few culls, and is altogether a very good commercial sort. The flesh is firm but juicy, with a sprightly, sub-acid flavor, and, though not high in quality, is still passable.

(8) Roxbury Russet

This is still another of the fine old varieties which have originated in Massachusetts and goes back to the seventeenth century. From a commercial standpoint it is undoubtedly the best of the russets and is especially valuable as an export variety, the English market being particularly strong on russets, and especially the Roxbury, since it is marketed late in the year. It is perhaps being planted less since cold-storage facilities have improved, but I believe it is still worthy of a place among our list of market varieties. As a cropper it is somewhat variable, but has a strong tendency to annual bearing when well cared for, as it does not tend to overbear. The tree is medium to large in size and rather a vigorous grower, making usually a flat top. Its principal weakness, so far as the writer knows it, is a tendency to European canker where that disease is common. It makes a twiggy growth, being full of short fruit spurs and easily recognized by one familiar with the variety. The fruit is medium to large, being rather variable in both size and shape. It is sometimes oblate, sometimes somewhat conic and almost always irregular in cross-section. For this reason it is not a good variety for boxing, though these objections apply less to the fruit on well-cared-for trees than on those which receive less care. The flesh is yellowish in color, very firm, but reasonably tender and juicy, with a sprightly sub-acid flavor. In quality it would rank, in the writer's opinion, as good to best. There seems to be considerable objection to it as a commercial variety for our American markets, but I believe that this objection is going to disappear as people become accustomed to attaching less importance to the red skin of an apple.

(9) Palmer Greening (or Washington Royal)

This is still another Massachusetts apple, having originated at Sterling, Massachusetts. The tree is only moderately vigorous, even when young, and attains

at full age only moderate size, not nearly as large as the Rhode Island Greening. It comes into bearing reasonably early, from six to seven years, bears good crops biennially but has very little fruit in the off year. The fruit is greenish in color, or yellowish when fully ripe, and usually has a distinct blush on the sunny side, making it a decidedly attractive apple to any one who is not wedded to a red variety. There is an indication of quality to a good Palmer Greening that is very attractive, particularly to one who has ever eaten it. It is especially valuable as a dessert apple, as its quality ranks from good to best. Professor Dickens, of Kansas, wrote recently of some Palmer Greenings which had been sent him for his class in pomology: "Two out of eight in my senior class pronounced it the best apple they had ever eaten, and they know Grimes Golden and Jonathan pretty well." It will keep till December, or even till March, in good storage, and its medium size and very uniform shape and size make it an ideal box apple. In my opinion it ought to be grown more extensively in Massachusetts.

(10) Sutton (Beauty)

The Sutton is supposed to be a seedling of the Hubbardston and originated in Sutton, Massachusetts. The tree is vigorous and healthy, and very upright in growth. One who had become familiar with the Sutton tree would always be able to pick it out. It has a marked tendency to bear biennially, which is an objection. While as yet not at all well known as a market variety, I believe it is one of the coming market varieties. Beach says of it: "In color, texture, quality and season the Sutton is intermediate between the Baldwin and the Hubbardston." It is very uniform in both size and shape, being rather above medium in size and of a fine conic shape. It is excellent in quality and of fine red color. It seems specially suited to the fancy box trade, but its flesh is a little too tender for the general market, though it is all right in barrels if handled carefully. I believe it is the type of apple which ought to be grown here in Massachusetts and am glad to note that Beach reports it as one of the coming commercial apples in New York.

(11) Gravenstein

This is a German variety introduced into the United States about 1826. Its very attractive appearance and excellent quality make it popular, even in spite of the fact that as a rule it is not very productive. For cooking it is not excelled by any variety of its season, and when fully ripe and not overripe it is an excellent dessert variety. The tree is a very vigorous grower, in fact, too vigorous unless handled carefully, having a tendency to grow too late in the fall and to be damaged by the severe weather which follows. It is liable to sun-scald and to canker. It comes into bearing fairly early, usually from seven to eight years, and is a reliable cropper, though not a heavy one, with a considerable tendency to bear biennially. The fruit ripens quite unevenly and ought to be picked twice or even three times to secure the best results. The season is from the middle of September until November. It may be kept later than this in good storage, but the color fades badly if it is kept much beyond its season, far more than the McIntosh does. It is apt to grow a good many culls, particularly in the off year, running very variable in both shape and size. Where it succeeds no other apple of its season can compete with it in the market. In quality it ranks from good to best.

(12) Red Astrachan

This is another of the Russian apples which has achieved success in the United States, and which I should include as a commercial apple for Massachusetts. It is very early in season, following the Yellow Transparent, and being fit for cooking in July. It is consequently a profitable variety for local markets and for home use, while its attractive color combined with its earliness make it popular. It is, however, very tender in flesh, and will not stand shipping well. It is principally valuable as a cooking apple, though well-grown, fully developed specimens are very good eating. The tree is medium in size, coming into bearing very

early, and is reasonably productive, though inclined to bear biennially. Its tendency to be irregular in both size and shape is rather a serious drawback to a commercial variety, making quite a loss from unmarketable fruit. The fruit drops considerably, unless several pickings are made.

(13) Fall Pippin

The origin of this variety is somewhat in doubt, but it is good enough so that its origin does not much matter. It ought to have originated in Massachusetts. The tree is large and rather vigorous, making a roundish, rather dense top. Both leaves and fruit are seriously subject to the apple-scab fungus, which is a decided drawback where this disease is troublesome. The fruit ripens very unevenly, which is another objection, as it means repeated pickings, which add somewhat to the expense. The fruit is large, of a fine, clear yellow and decidedly handsome, having a clean, attractive appearance which makes it sell well. The flesh is fine-grained, tender and juicy, rather aromatic, and ranks as good to best in quality. It is a fine dessert apple but is especially strong as a culinary variety. In storage it is a variable keeper, but in any case has a long season, owing to its uneven ripening, beginning in September and lasting well on toward Christmas. I should consider it among the best of the fall varieties for home use and a good commercial sort.

(14) Westfield (Seek-no-further)

The Westfield, or Westfield Seek-no-further, is still another of the Massachusetts contributions to the list of fine varieties of apples. It originated at or near Westfield, in the neighborhood of Springfield, Massachusetts. The tree is very hardy, healthy and long-lived, though inclined to be a biennial bearer. It is nevertheless a very reliable cropper. The fruit is of highest quality, with a nutty, aromatic flavor which one who has once known it cannot forget. It is not particularly attractive in appearance, being a rather dull brownish-red, but when well grown, and especially when grown on sandy or gravelly soil, where it succeeds best, it often attains a fine, handsome red, which makes it really attractive. It runs very uniform in both size and shape, making it a good box apple, and as it is principally used as a dessert apple (not being a very good cooker), this is the way it ought to be marketed. Its season is from about October to February, but it will often keep in good storage much later than this. It stands handling and shipping well, and in a limited way I believe it would be profitable as a commercial variety. Certainly it ought to be in every family orchard.

(15) Northern Spy

The Spy is one of the few imported commercial apples which Massachusetts cannot claim, as it originated in New York. It is one of my sincere regrets that the Spy does not succeed better in Massachusetts. There are certain sections where it does admirably, particularly in Franklin county, but as a rule it has the reputation of not being a success with us. Whether it altogether deserves this reputation is a question, but certainly we do not grow good Spies in many sections. The tree is all that could be desired in health and vigor, making a fine-shaped, large tree, and living to a good old age, but it is very slow indeed in coming into bearing, in this respect standing at the foot of the list of reputable varieties. The fruit when well grown is about all that could be desired, being a fine, bright, pinkish-red in color, with a smooth, waxy skin, making an extremely attractive apple. The flesh is firm and crisp, but tender and juicy, and has a flavor that no one will forget, once he has eaten a well-grown, well-colored Spy. Both fruit and foliage are decidedly subject to the attacks of the scab fungus where this disease is prevalent, and its tender skin and flesh make careful handling necessary. But, with all its faults, I should say that in sections where it is known that the Spy succeeds it ought to be put down as one of our leading varieties. In other sections it had probably better be tried only on a small scale; but even here, unless it has been tried under favorable conditions, with modern treat-

ment as to spraying, etc., I believe it is worth experimenting with.

(16) Yellow Transparent

This is the third Russian in the list and is included principally because of its very early season, ripening in July, when every one is apple-hungry. The tree is very hardy and healthy and comes into bearing very young indeed. Grafts often bear the second year, and sometimes even the year they are set, the trees usually bearing a reasonable crop the third and fourth years. It is a good, reliable cropper, but ripens so unevenly that it requires two or three pickings to secure the fruit in the best condition. The fruit is a very handsome clear yellow, but both the flesh and skin are tender and it therefore bruises easily and shows the marks of careless handling. It is a fine cooking apple and good specimens are not by any means bad eating. Where early fruit commands a good price and for nearby markets it will prove a profitable variety.

(17) Blue Pearmain

This is a fine old variety, but is not very generally grown, and it is not recommended here except for the family orchard or in a limited way in commercial plantings. To one who knows and likes the good old-fashioned sorts the Blue Pearmain is always very acceptable. The tree is a good, strong grower and long-lived. The fruit is mild in flavor but aromatic and fine with a rich appearance in well-grown specimens which is attractive. The skin is a little rough and rather thick. The color is deep orange-yellow, splashed and striped and shaded with very dark red, and the heavy white bloom over this gives a bluish appearance. The flesh is firm, yellowish, moderately juicy and aromatic.

F. C. Sears,
Professor of Pomology, Massachusetts Agricultural College.

Production of Fruits in Massachusetts

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	....	9,552	8,346	29,260,143	$1,676,790
Strawberries	4,654	2,015	2,027	5,518,867	495,438
Blackberries and dewberries	1,368	287	365	307,987	31,454
Raspberries and loganberries	1,506	388	413	376,136	55,757
Currants	1,536	243	190	213,810	19,904
Gooseberries	330	42	30	57,827	5,007
Cranberries	1,350	6,577	5,128	22,714,496	1,062,205
Other berries	61	....	193	71,020	7,025

Cranberries are by all odds the most important of the small fruits grown in Massachusetts, with strawberries ranking next. The total acreage of small fruits in 1909 was 9,552 and in 1899, 8,346, an increase of 14.5 per cent. The production in 1909 was 29,260,000 quarts, as compared with 25,882,000 quarts in 1899, and the value $1,677,000, as compared with $1,494,000. The quantity and value of products thus increased somewhat less, relatively, than the acreage.

Orchard fruits, grapes, and nuts: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is, on the whole, a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	....	1,698,220	....	591,796	2,763,679	$2,074,270	3,158,781
Apples	27,937	1,367,379	9,278	355,868	2,550,259	1,780,290	3,023,436
Peaches and nectarines	5,038	154,592	3,252	162,114	91,756	138,716	27,906
Pears	13,920	113,365	3,535	38,378	96,071	110,069	89,011
Plums and prunes	6,057	41,345	2,932	23,871	17,814	28,253	5,919
Cherries	3,902	13,396	1,662	6,776	4,761	10,848	6,043
Apricots	172	654	89	258	148	326	25
Quinces	1,708	7,484	804	4,531	2,863	5,754	(2)
Mulberries	2	5	....	....	7	14	(2)
Unclassified	....	....	....	....	....	....	[3] 6,441
Grapes	6,003	58,277	1,204	14,261	1,132,838	30,858	1,308,300
Nuts, total	....	[4] 6,720	....	[4] 2,030	[4] 134,920	[4] 3,671	462,800
Black walnuts	280	1,910	41	434	40,064	1,219	(2)
Butternuts	268	1,691	21	179	60,151	984	(2)
Hickory nuts	188	1,672	20	1,306	23,834	904	(2)
Unclassified	....	....	....	....	....	....	[3] 462,800

[1] Expressed in bushels for orchard fruits and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes chestnuts, almonds, hazelnuts and beechnuts.

The total quantity of orchard fruits produced in 1909 was 2,764,000 bushels, valued at $2,074,000. Apples contributed more than nine-tenths of this quantity; peaches and pears most of the remainder. The production of grapes and nuts was relatively unimportant. The nuts consisted chiefly of black walnuts, butternuts, and hickory nuts.

The value of orchard fruits increased from $1,171,000 in 1899 to $2,074,000 in 1909, but that of grapes declined from $35,685 in 1899 to $30,858 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	6,562	17.8	Gals	1,004,392	1,114,029
Vinegar	1,651	4.5	Gals	133,653	135,482
Wine and grape juice	532	1.4	Gals	12,937	10,266
Dried fruits	25	0.1	Lbs........	465	7,530

Sugar crops: 1909 and 1899. The table below shows data with regard to maple trees and their products, and also for sugar beets and sorghum cane, which in this state are unimportant. The total value of maple sugar and sirup produced in 1909 was $77,559, as compared with $48,236 in 1899.

PRODUCT	Farms reporting		Acres	Product		
	Number	Per cent of all farms		Amount	Unit	Value
Maple Sugar and Sirup:						
Total, 1909.	1,525	4.1	[1] 256,501			$77,559
Sugar made.	442	1.2		156,952	Lbs..	22,277
Sirup made.	1,457	3.9		53,091	Gals..	55,282
Total, 1899.	1,000	2.7				48,236
Sugar made.				192,990	Lbs.	21,124
Sirup made.				27,174	Gals..	27,112
Sugar beets, 1909[2]	65	0.2	74	742	Tons..	9,269
Sorghum cane, 1909[3]	1	[4]	3	30	Tons..	500

[1] Number of trees.
[2] Used as root forage.
[3] Used as coarse forage.
[4] Less than one-tenth of 1 per cent.

McIntosh Apple for Massachusetts. See *Massachusetts.*

McLaughlin, Dr. John. See *History of Orcharding in Old Oregon,* under *Apple.*

Medlar

The Medlar is a small, spreading European tree of the family *Rosaceae.*

The fruit resembles a very small apple with the calyx lobes well developed and permanent. It is hard and bitter until it begins to decay, when it becomes agreeably acid. It is not highly prized as a food but is a relish or delicacy.

The timber of the Medlar is rather hard and durable. The tree is a slow grower and lives to a very great age.

Meek, William. See *History of Orcharding in Old Oregon,* under *Apple.*

Melon or Cotton Aphis. See *Aphids.*

Melon Aphis. See under *Cantaloup Culture.*

Mice. See *Rodent.*

Michigan

The northern part of Michigan is rugged and mountainous. The principal industries are lumbering and mining. There is but little fruit grown in this part of the state and farm lands have not been regarded as very productive when averages are considered. The northern section is separated from the southern by the Straits of Mackinac, connecting Lakes Huron and Michigan.

The southern part, sometimes called the Southern Peninsula, is a part of an old coastal plain whose layers contain salt, gypsum, sand, clay and glacial deposits. The soils are for the most part productive, and especially on the western coast, bordering on the shores of Lake Michigan, are adapted to fruit-growing on account of protection from frosts by the lake breezes. The soil of Southwest and Southeast Michigan is mainly a dark clay loam or muck; in the north central part of the lower peninsula it is a light sandy loam; in the east along the shores of Lake Huron it is mostly a blue clay.

The climate, except where the temperature is modified by lake breezes, is cold in winter, the thermometer ranging as low as 49 degrees below zero and as high as 104 degrees above, but in the southwest portion the temperature is much less extreme, so that peaches, pears, apples and all kinds of orchard fruits of the north temperate zone may be grown.

Celery, potatoes and peppermint are important commercial crops. The total number of fruit trees in the state is reported as follows:

Apples, 7,534,343; peaches and nectarines, 2,907,170; pears, 1,136,151; plums and prunes, 464,917; cherries, 760,183; grapevines, 11,013,576; strawberries, 8,051 acres; raspberries and loganberries, 8,786 acres; nuts, 37,297 trees.

The counties in which the largest number of bearing apple trees is reported are as follows: Allegan, 287,761; Berrien, 273,409; Kent, 307,385; Oakland, 285,983; Van Buren, 234,134. It will be noted that these counties, with the exception of Oakland, are in the southwestern part of the state. All of the great peach-producing counties are along the shores of Lake Michigan, where the soil and climate are both favorable for their production. Granville Lowther

Frost and Precipitation in Michigan

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Calumet	Oct. 8	May 11	Sept. 16	June 5	31.7
Marquette	Oct. 2	May 15	Aug. 22	June 11	32.4
Sault Ste. Marie	Sept. 24	May 16	Sept. 5	May 29	32.4
Escanaba	Oct. 1	May 14	Sept. 9	June 16	31.5
Cheboygan	Sept. 16	May 22	July 10	June 8	30.3
Alpena	Sept. 26	May 14	Sept. 6	June 9	33.7
Ivan	Sept. 14	May 23	July 11	June 9	82.4
Grayling	Sept. 12	May 25	July 11	June 9	28.8
Harbor Beach	Oct. 7	May 12	Sept. 18	June 9	26.9
Alma	Sept. 26	May 8	Sept. 11	May 26	33 2
Arbella	Sept. 11	May 13	July 17	May 28	33.2
Grand Haven	Oct. 10	Apr. 28	Sept. 23	May 28	35.3
Port Huron	Oct. 9	May 8	Sept. 23	June 6	31.0
Hastings	Sept. 15	May 10	July 12	May 31	33.5
Lansing	Oct. 8	Apr. 25	Sept. 20	May 31	29.2
Ball Mt	Oct. 1	May 9	Sept. 14	June 9	81.5
Kalamazoo	Oct. 9	Apr. 24	Sept. 20	May 13	34.8
Detroit	Oct. 9	Apr. 28	Sept. 17	May 31	32.2
Adrian	Oct. 11	Apr. 27	Sept. 20	May 13	34.6

Production of Fruits in Michigan

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	...	21,419	29,197	27,214,659	$2,028,865
Strawberries	16,798	8,051	10,837	14,218,768	1,000,788
Blackberries and dewberries	4,707	2,973	4,385	3,075,954	218,174
Raspberries and loganberries	11,075	8,786	10,193	8,381,943	695,019
Currants	3,458	609	2,286	768,259	58,288
Gooseberries	1,637	297	559	403,680	28,932
Cranberries	91	202	150	125,536	6,992
Other berries	141	501	787	240,519	20,672

Strawberries are by far the most important of the small fruits raised in Michigan, with raspberries and loganberries ranking next, and blackberries and dewberries ranking third. The total acreage of small fruits in 1909 was 21,419 and in 1899, 29,197, a decrease of 26.6 per cent. The production in 1909 was 27,215,000 quarts, as compared with 40,168,000 quarts in 1899, and the value $2,029,000, as compared with $1,680,000.

Orchard fruits, grapes, and nuts: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes, and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely compar-

able, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 15,220,000 bushels, valued at $9,021,000. Apples contributed about four-fifths of this quantity, peaches and nectarines and pears most of the remainder. The production of grapes in 1909 amounted to 120,696,000 pounds, valued at $1,531,000, and of nuts to 961,000 pounds valued at $19,000. Most of the nuts consisted of black walnuts, hickory nuts, and butternuts.

The production of all orchard fruits together in 1909 was 54.4 per cent more than in 1899, while the production of grapes was about three times as great in 1909 as in 1899. The value of orchard fruits increased from $3,676,000 in 1899 to $9,021,000 in 1909, and of grapes from $503,000 in 1899 to $1,531,000 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	......	12,842,827	....	6,679,949	15,220,104	$9,020,842	9,859,862
Apples	153,026	7,534,343	87,846	2,253,072	12,332,296	5,969,080	8,931,569
Peaches and nectarines	47,060	2,907,170	28,377	2,991,090	1,686,586	1,700,330	339,637
Pears	75,567	1,136,151	29,058	623,931	666,023	535,771	170,702
Plums and prunes	49,498	464,917	25,331	253,479	181,188	205,765	213,682
Cherries	73,913	760,183	29,792	540,580	338,945	590,829	194,541
Apricots	1,512	4,447	751	2,450	1,508	2,127	730
Quinces	7,283	35,461	2,508	15,302	13,484	16,858	(2)
Mulberries	38	155	16	45	74	82	(2)
Unclassified	......	....	....	....	....	....	[3] 9,001
Grapes	41,485	11,013,576	11,040	1,869,648	120,695,997	1,531,057	41,530,369
Nuts, total	......	[4] 37,297	......	[4] 7,500	[4] 961,137	[4] 18,956	470,700
Black walnuts	2,429	16,105	401	3,520	546,779	7,804	(2)
Butternuts	613	2,929	64	545	112,488	1,552	(2)
Chestnuts	152	3,174	34	867	23,369	2,762	(2)
Hickory nuts	1,655	14,943	88	2,513	276,015	6,681	(2)
Unclassified	......	......	....	....	....	....	[3] 470,700

[1] Expressed in bushels for orchard fruits and pounds for grapes and nuts.

[2] Included with "unclassified."

[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."

[4] Includes almonds, pecans, filberts, hazelnuts, sweet nuts, beechnuts and other nuts.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	42,663	20.6	Gals	3,386,138	2,295,562
Vinegar	12,650	6.1	Gals	602,697	434,574
Wine and grape juice	4,259	2.1	Gals	199,030	134,859
Dried fruits	818	0.4	Lbs	48,328	143,330

Minnesota

Minnesota is one of the North-Central states. The Encyclopedia Britannica describes Minnesota in part as follows: "The northeast part of the state is included in the Great Lakes province. The whole area of the state was formerly a complexly folded mountain region of strong relief, which was afterwards worn down to a more nearly level surface except in the extreme northeast corner, where the ridges of harder rock resisted erosion. Marine deposits were laid down over the south of the state after a submergence of the region; an uplift afterward made of these deposits a coastal plain. The rather level surfaces of the worn-down mountains in the north of the state and the coastal plains bed of the southern and western parts are now dissected by rivers, which makes most of the state a rolling or hilly country without strong relief."

About two-thirds of the state drains into the Mississippi river, thence into the Gulf of Mexico, while the northwest part drains into the Red river, Lake Winnipeg and Hudson bay. A portion of the northeast drains into streams emptying into Lake Superior.

Minnesota has numerous swamps and more than 10,000 lakes, the beds of which were formed by glacial action. The largest of these is Red lake, with an area of 342 square miles.

The climate of Minnesota is severe but the atmosphere is dry, which fact somewhat neutralizes the severe effects. The average annual rainfall throughout the state is 26.6 inches. The soil is generally a dark sandy loam and very fertile. Many of the swamps are being drained and are very productive.

With the exception of apples there is very little fruit grown in the state. There is reported 1,380,396 bearing apple trees. The only commercial apple-growing of consequence is in the southeastern part of the state, near the Mississippi river.

The counties producing the largest amounts of apples are as follows: Blue Earth, 56,740 trees; Fillmore, 80,743; Freeborn, 51,842; Hennepin, 96,713.

No peaches of consequence are grown and the plums and prunes are estimated at 233,736 trees. Strawberries are estimated at 1,873 acres, and raspberries and loganberries at 1,388 acres.

At the present time Minnesota does not supply its own population with fruits, but considerable quantities are shipped to St. Paul, Minneapolis, Duluth and other cities, annually, while the state ships out wheat, potatoes and other products, to which the soil is particularly adapted. It is claimed that the apple best suited to Minnesota conditions is the Duchess of Oldenburg.

GRANVILLE LOWTHER

Frost and Precipitation in Minnesota

Station	Frost: Average Date of First Killing in Autumn	Frost: Average Date of Last in Spring	Frost: Date of First in Autumn	Frost: Date of Last in Spring	Precipitation: Annual inches
Crookston	Sept. 18	May 19	Aug. 28	June 4	22.6
Mt. Iron	Sept. 12	June 4	Sept. 7	June 23	33.3
Moorehead	Sept. 20	May 14	Aug. 25	June 8	24.5
Park Rapids	Sept. 15	May 24	Aug. 26	June 11	26.9
Sandy Lake Dam	Sept. 17	May 19	Aug. 27	June 11	27.0
Duluth	Oct. 4	May 3	Sept. 15	June 8	29.9
Fergus Falls	Sept. 17	May 11	Sept. 8	June 2	23.2
Morris	Sept. 21	May 12	Aug. 23	June 7	23.0
Cedarville	Sept. 29	May 1	Sept. 11	May 19	21.9
Bird Island	Sept. 22	May 7	Sept. 9	June 7	23.9
Minneapolis	Oct. 7	Apr. 25	Sept. 13	May 20	28.4
St. Paul	Oct. 5	May 6	Sept. 20	May 25	28.6
Luverne	Sept. 19	May 11	Sept. 11	May 31	28.2
Rolling Green	Oct. 3	May 4	Sept. 12	May 31	26.3
Grand Meadow	Sept. 23	May 12	Sept. 11	June 7	32.7

Production of Fruits in Minnesota

Small fruits: 1909 and 1899. The next table shows data with regard to small fruits on farms.

Strawberries are by far the most important of the small fruits raised in Minnesota, with raspberries and loganberries ranking next in importance. The total acreage of small fruits in 1909 was 3,738 and in 1899, 3,092, an increase of 20.9 per cent. The production in 1909 was 4,477,000 quarts, as compared with 4,543,000 quarts in 1899, and the value $493,000, as compared with $340,000.

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total		3,738	3,092	4,476,575	$493,406
Strawberries	9,420	1,873	1,302	2,730,099	268,772
Blackberries and dewberries	848	145	162	139,741	17,696
Raspberries and loganberries	4,890	1,388	1,115	1,340,469	178,689
Currants	3,053	200	259	182,825	19,783
Gooseberries	1,807	71	112	60,661	6,412
Cranberries	264	61	22	22,112	1,981
Other berries	6	(1)	120	668	73

[1] Reported in small fractions.

Orchard fruits, grapes, and nuts: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910: Farms reporting	Trees or Vines of bearing age 1910: Number	Trees or Vines not of bearing age 1910: Farms reporting	Trees or Vines not of bearing age 1910: Number	Product 1909: Quantity[1]	Product 1909: Value	Product 1899: Quantity
Orchard Fruits, total		1,644,590		1,787,107	1,066,659	$801,112	143,655
Apples	59,780	1,380,396	55,340	1,571,816	1,044,156	769,114	120,143
Peaches and nectarines	101	1,571	185	3,837	599	659	190
Pears	264	2,792	440	4,135	400	465	226
Plums and prunes	14,914	233,736	13,265	167,926	19,920	27,808	21,820
Cherries	4,207	25,139	6,160	38,399	1,526	2,973	960
Apricots	22	66	53	175	10	13	2
Quinces	18	167	31	681	2	5	(2)
Mulberries	6	723	5	138	46	75	(2)
Unclassified							[3] 314
Grapes	2,138	61,916	1,639	35,950	293,805	11,021	573,272
Nuts, total		[4] 8,110		[4] 7,047	[4] 81,555	[4] 1,838	33,700
Black walnuts	321	7,036	257	6,307	65,074	1,490	(2)
Unclassified							[3] 33,700

[1] Expressed in bushels for orchard fruits and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes Persian or English walnuts, almonds, pecans, butternuts, hickory nuts, chestnuts, hazelnuts and other nuts.

The total quantity of orchard fruits produced in 1909 was 1,067,000 bushels, valued at $801,000. Apples contributed 97.9 per cent of this quantity, plums and prunes most of the remainder. The production of grapes in 1909 amounted to 293,805 pounds, valued at $11,021, and that of nuts to 81,555 pounds, valued at $1,838.

The production of all orchard fruits to-

gether in 1909 was about seven and one-half times that of 1899, but the production of grapes declined. The value of orchard fruits increased from $109,000 in 1899 to $801,000 in 1909, while that of grapes declined from $15,593 in 1899 to $11,021 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	215	0 1	Gals.	9,044	6,111
Vinegar	168	0 1	Gals	5,778	3,339
Wine and grape juice	425	0 3	Gals	4,567	6,197
Dried fruits	101	0 1	Lbs	2,853	500

MINOR ARTICLES OF FARM EQUIPMENT. See under *Farms*.

Mississippi

Mississippi has an area of 46,340 square miles. There are no mountains in the state, but a considerable difference exists between the continuous low, flat alluvial regions lying along and between the Mississippi and Yazoo rivers, called the bottoms, and nearly all the remainder of the state, called the uplands. These uplands are an undulating plateau, whose general elevation rises to 150 feet above the Gulf of Mexico within a few miles of the coast and varies further inland to a height of 600 feet. There are some exceptional ridges rising to a height of 800 to 1,000 feet.

The streams of this region flow in valleys that range in width from a few rods to several miles, sometimes making a broad stretch of level bottom land of exceeding fertility.

The state lies in what is called the semi-tropical belt. The winters are short and mild and the summers are not so intensely hot as the latitude would indicate on account of the breezes from the Gulf, which modify the temperature.

The soil is very fertile, especially in the river bottoms and the delta, which comprises a plain almost as level as the surface of the ocean and of inexhaustible richness.

The table lands are also fertile. For the most part they are formed of calcareous loam, calcareous silt, and, in the eastern part of the state, of brown loam, all of which are highly productive.

The yellow loam of the hills and the sandy loam of the pine belt are inferior in quality, but taken as a whole, perhaps there is no state in the Union more productive than Mississippi.

Vegetables are grown extensively along the rivers and in the region of the delta and shipped in large quantities to the markets of the cities along the Atlantic coast.

The sassafras, persimmon, wild cherry and Chickasaw plums are found growing wild in all parts of the state. The grape, Ogeechee lime and paw-paw, blackberries, dewberries and strawberries all grow luxuriantly.

The principal fruit crop is peaches, to which the soil and climate in parts of the state are well adapted. Pears have been planted in considerable numbers, but have been so subject to blight that, in most localities, the growers have become discouraged and have given up the enterprise. Pear growing in the state is therefore not considered a success.

Apple growing in the state is not a

large industry because the latitude is not favorable for apples. However, the early summer varieties are grown in considerable quantities for the early market because they can be shipped in competition with storage fruits grown in the northern regions, and by some persons are considered preferable.

Among the most profitable of small fruits is the strawberry, which can be successfully grown in almost all parts of the state, can be placed in the early markets of the North and sold at good prices. Grapes also can be grown in most parts of the state and the long seasons are favorable for the rapid growth of the vine.

The mean temperature of Mississippi is 64 degrees Fahrenheit for the state, 67 degrees Fahrenheit for the coast, and 61 degrees Fahrenheit for the northern border. During a period of 20 years the extremes of temperature ranged at the coast from 1 degree to 100 degrees Fahrenheit.

GRANVILLE LOWTHER

APPLE GROWING IN MISSISSIPPI

Apple growing may never be of great commercial importance in Mississippi, but the writer sees no reason why it should not be of much more importance than it now is. It has been demonstrated that good apples can be grown in the state and at a profit. Even if they could not be grown commercially there is no reason why the farmer cannot grow enough for home use. It is often said that apples can be bought cheaper than they can be grown in the South. Granting this to be true, can the farmer and others who would buy them get apples and good ones when they want them? Very few first-class apples reach the smaller towns in Mississippi. The bulk of the apples found on our local markets are No. 2s or culls. These have sold at times for $2 and more per bushel by retail and found the demand at these prices greater than the supply.

Diversification is the keynote to success on the farm. Fruit should be regarded not as a luxury but as a necessary article of food. The sooner more of our farmers cultivate the habit of growing a greater variety of food crops at home the sooner we will be on the road to prosperity. The less we buy and the more of the surplus we sell the greater will be our progress.

The Future of the Apple Industry

The market apples of the future will be produced by specialists, men who will devote their time and thoughts to the study of the problems. This change may be looked upon as a step in advance, for specialization is an evidence of evolution and advancement. More and better fruit at a lower price will be the result.

Within the past decade more fruit trees have been planted than ever before and within a short time we may expect a great increase in the supply of apples.

H. C. THOMPSON,
Agricultural College, Mississippi.

Time to Plant in Mississippi

While fruit trees and grapes may be planted at any time during the dormant or inactive period from November to March, it is best to set them as early as possible after the advent of cool, frosty weather. When they are set at this time, the soil settles down nicely about the plants with the first rains; the cut surfaces at the ends of the roots soon heal over, and before midwinter quite a system of newly formed roots will have developed, thus insuring greater immunity from adverse conditions during the following spring and summer than is possible with later plantings. Midwinter plantings should be made only during mild weather and when the soil is in good working condition. When planting is deferred until March greater care should be given to the preparation of the soil and to the work of setting. If dry weather prevails water should be applied freely to each tree or vine while it is setting to settle the soil properly about the roots. If dry weather continues, newly set trees and vines may require water several times before growth is established. After each application of water the soil about the plants should be stirred to prevent crust-

ing and too rapid evaporation. A covering of half-rotted leaves or straw placed within a radius of three feet around the tree will conserve moisture and keep the soil mellow and cool. Following this plan the writer has had success with trees received for trial and planted late in March.

A. B. McKay

Varieties for Mississippi

The question of what varieties to plant is one of the hardest to answer, for some varieties are adapted to certain conditions while other varieties are not at all suited. Whether selecting for a home or commercial orchard, would determine what varieties to plant. For commercial purposes we would select a few standard varieties of vigorous-growing trees which bear well and produce fruit of a good color and size that ripens evenly, stands storage, and ships well. These characteristics are sometimes found in varieties like the Ben Davis and Gano, which are very poor in quality. For home orchards we would choose a larger number of varieties with special reference to quality, and without considering shipping properties or appearance.

There is only a limited number of varieties of apples adapted to the South and only a few of these have been tried in Mississippi. Among the varieties that are adapted to growing in this state are the following: Red June, Early Harvest, Red Astrachan, Yellow Transparent, Champion, Commerce, Black Ben Davis, Day, Yates, Horse, and Roxbury Russet. The first four are early summer varieties while the others are either late summer or fall and winter varieties. There has been so little work done on the apple in this state that very little is known about its adaptability.

Other Fruits

While the following is by no means an exhaustive list of good varieties, it includes such as, upon repeated tests, have been found worthy of place in Mississippi orchards, vineyards and strawberry plantings. Names are given in approximate order of ripening.

Apple—Red June, Astrachan, Transparent, Carolina Watson, Day, Horse, Bonum, Carolina Greening, Roxbury Russet, Commerce, Champion, Black Ben Davis, Winter Queen, Stevenson's Winter.

Peach—Alexander, Greensboro, Mamie Ross, Carmen, Belle of Georgia, O. M. Free, Thurber, Family Favorite, Hiley, General Lee, Elberta, Globe, Crawford's Late, Stonewall Jackson, Emma, Columbia, Picquet's Late, Indian Blood, Pineapple or Lemon.

Plum—Wild Goose, Milton, Abundance, Red June, Burbank, Ogon, Doris, Apple.

Pear—Koonce, Garber, Duchesse d'Angoulem, Kieffer, Seckle.

Quince — Angiers, Apple, Chinese, Rea's.

Fig—Brown Turkey, Celestial, Green Ischia.

Grape—Moore's Early, Perkins, Delaware, Diamond, Concord, Niagara, Goethe.

Strawberry—Excelsior, Lady Thompson, Klondike, Aroma, Gandy.

If planting cannot be done immediately upon arrival of trees, dig a trench in some well-drained place, stand the trees in the trench and bank well-pulverized soil about the roots, covering deeper than they stood in the nursery. If goods are frozen upon arrival, place in cellar or some other cool, dark apartment and let remain without unpacking until the entire package is thawed out.

When ready to plant inspect each tree carefully and remove any insects that may be found on or beneath the bark of roots or stem. With a sharp knife or pruning shears trim off all bruised parts, leaving a smoothly cut surface at the end of each root.

For additional information on Orchard Sites and Soils, see *Selection of Site*, under *Apple Orchard.*

Frost and Precipitation in Mississippi

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Batesville	Oct. 24	Mar. 24	Oct. 9	Apr. 7	48.0
Pontotoc	Oct. 28	Mar. 25	Oct. 9	Apr. 9	49.8
Pal Lato	Nov. 4	Mar. 27	Oct. 15	Apr. 22	51.8
Greenville	Oct. 31	Mar. 15	Oct. 9	Mar. 30	45.9
Louisville	Nov. 3	Mar. 21	Oct. 16	Apr. 10	51.0
Yazoo City	Nov. 2	Mar. 27	Oct. 21	Apr. 21	48.0
Canton	Nov. 4	Mar. 20	Oct. 15	Apr. 7	49.6
Vicksburg	Nov. 12	Mar. 17	Oct. 19	Apr. 6	53.8
Meridian	Oct. 31	Mar. 26	Oct. 8	Apr. 10	53.4
Crystal Springs	Nov. 1	Mar. 28	Oct. 15	Apr. 21	53.3
Natchez	Nov. 14	Mar. 14	Oct. 27	Mar. 30	50.0
Hattiesburg	Nov. 12	Mar. 10	Oct. 25	Mar. 30	48.1
Magnolia	Nov. 8	Mar. 16	Oct. 25	Apr. 7	61.0
Biloxi	Nov. 26	Feb. 27	Oct. 22	Mar. 26	61.3

Southern Mississippi

For Bloom Period of Apples, see *Louisiana*.

Production of Fruits in Mississippi

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	....	836	1,549	1,407,301	$107,171
Strawberries	785	772	1,383	1,345,013	101,882
Blackberries and dewberries	672	58	84	53,735	4,531
Raspberries and loganberries	100	5	49	7,806	673
Currants	11	(1)	3	362	52
Gooseberries	3	1	1	285	28
Other berries	1	(2)	29	100	5

[1] Reported in small fractions.
[2] Less than 1 acre.

Strawberries are by far the most important of the small fruits raised in Mississippi. The total acreage of small fruits in 1909 was 836, and in 1899, 1,549, a decrease of 46 per cent. The production in 1909 was 1,407,000 quarts, as compared with 1,735,000 quarts in 1899, and the value was $107,000 in 1909, as compared with $141,000 in 1899.

Orchard fruits, grapes, nuts, and tropical fruits: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes, nuts, and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or

tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 1,634,000 bushels, valued at $1,326,000. Peaches and nectarines contributed about two-thirds of this quantity, apples, plums and prunes, and pears most of the remainder. The production of grapes in 1909 amounted to 760,563 pounds, valued at $44,262, and that of nuts to 866,504 pounds, valued at $90,855.

The production of all orchard fruits together in 1909 was 167.5 per cent more in quantity than that in 1899, while the production of grapes decreased materially. The value of orchard fruits increased from $440,000 in 1899 to $1,326,000 in 1909, and that of grapes from $39,277 in 1899 to $44,262 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	.....	2,554,756	....	1,353,998	1,634,305	$1,325,506	610,927
Apples	42,052	427,652	36,893	425,323	265,841	213,714	249,035
Peaches and nectarines	67,382	1,726,298	36,645	724,895	1,156,817	925,288	252,305
Pears	21,442	118,556	20,432	101,209	101,288	96,777	36,923
Plums and prunes	12,073	257,140	6,582	83,154	101,974	79,971	66,793
Cherries	3,040	13,748	2,129	9,267	2,819	3,749	2,352
Apricots	2,235	4,906	2,096	4,983	2,277	2,510	772
Quinces	2,268	5,921	1,753	4,792	2,725	2,863	(2)
Mulberries	93	535	43	375	564	634	(2)
Unclassified	...	.....	....	....	....	....	[3] 2,747
Grapes	8,271	77,012	5,084	34,870	[4] 760,563	44,262	[4] 1,070,625
Nuts, total	.....	[5] 66,727	.....	[5] 157,670	[4 5] 866,504	[5] 90,855	[4] 313,620
Persian or English walnuts	893	2,705	1,239	5,513	66,492	6,949	5,670
Pecans	4,288	60,524	6,671	148,030	637,293	79,936	242,300
Black walnuts	818	2,914	638	2,391	151,406	3,700	(2)
Unclassified			....	....	....	....	[3] 65,650
Tropical Fruits, total	......	[6] 77,294	.....	[6] 79,999	.....	[6] 119,129	....
Figs	15,457	65,397	5,929	38,654	[4] 1,949,301	107,609	[4] 61,600
Oranges	213	10,452	337	38,637	[7] 3,779	8,648	....
Pomeloes (grapefruit)	90	1,001	92	1,978	[7] 1,368	2,345	....

[1] Bushels.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Pounds.
[5] Includes almonds, chestnuts, hickory nuts, Japanese walnuts, hazelnuts, Japanese chestnuts, Spanish chestnuts and other nuts.
[6] Includes Japanese persimmons, lemons, pomegranates, kumquats and bananas.
[7] Boxes.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider.......	104	(1)	Gals...	1,337	15,120
Vinegar	1,411	0.5	Gals....	6,617	12,222
Wine and grape juice	915	0.3	Gals...	7,986	12,464
Dried fruits	1,428	0.5	Lbs ...	52,389	19,290

[1] Less than one-tenth of 1 per cent.

Missouri

Missouri has more apple trees of bearing age than any other state in the Union. This is because the Ozark region, in the southern part, seemed several years ago to be especially adapted to fruits, and was too rough for general farming as carried on in the leveler sections around it. The apple tree grew well, seemed well adapted and for a time brought large profits to the producers. The result was that thousands of acres of apple trees were planted, some of them without a knowledge of soil conditions or of how to produce the best commercial varieties. Some of the orchards have therefore proved to be disappointing, not because of any natural insurmountable barriers, but because of a lack of adaptation of varieties, and improper methods of work.

Missouri has an area of 69,415 square miles. The Missouri river divides the state into two parts, north and south, flowing in an easterly direction, from its junction with the Kansas river at Kansas City, to its junction with the Mississippi river, 12 miles above St. Louis.

The surface of the northern part of the state is undulating, in some parts broken and hilly, well watered, with skirts of timber along the bluffs and streams interspersed with fertile prairies, the soil of which is for the most part alluvial, with a strong admixture of vegetable matter.

The southern portion is much more uneven, containing a considerable percentage of high table lands, low lands that in order to be brought under cultivation must be drained, and fertile ridges and hills rising to the dignity of mountains. These mountains extend into Arkansas and Oklahoma and rise from 1,200 to 1,700 feet above the margins and from 1,700 to 2,100 feet above the level of the sea. The elevation gives a cooler temperature than the same latitudes on the lower lands, furnishes protection from the cold winds from the north, and gives air drainage which tends to protect the buds from the early spring frosts to which this region is somewhat subject.

Missouri has a medium climate, favorable for the growing of apples, peaches, pears, plums, cherries, apricots, prunes, grapes, strawberries and other fruits common to a temperate climate.

The soil of the Ozark region, where the commercial apples are mostly grown, contains a considerable amount of clay, which is chiefly silica, aluminum, with carbonates of lime, magnesium, gypsum and iron.

The Ozark region is geologically a region of decided uplift and forms a domelike elevation which is bowed up from the Missouri river to the Red river in Arkansas and from the Mississippi river to Oklahoma. The red clays have a considerable mixture of iron and these are considered best for general farming as well as for fruits. In some places there is a substratum of rock near the surface which renders it impossible for the trees to obtain sufficient nourishment, but this is not against the region in general. It only shows the importance of wisely selecting a site for an orchard.

The census of 1900 showed that Missouri had 20,0040,399 bearing apple trees,

while in 1910 it had only 14,359,673. This represents a loss in 10 years of 5,-680,726. This loss is accounted for in various ways, the details of which need not be analyzed here, but is due in part doubtless to a mistake in the choice of the dominant variety planted. Formerly the Ozark region was considered the home of the Ben Davis. It was probably true that this apple would reach as high a state of perfection here as in any part of the world, but it is equally true that the Ben Davis is a low-grade commercial apple and must be sold for a low price and small profits. It is notable now that the new orchards contain a much larger per cent of the higher grades than is found in the old orchards, and in talking with many fruit growers we found a tendency to plant largely of Jonathan and Delicious.

The counties in Missouri which have the largest number of bearing apple trees are: Andrew, 297,379; Buchanan, 317,835; Holt, 251,192; Nodoway, 252,040 and Platte, 216,253; all of these are in the northwest, in territory drained by the Missouri river. In the Ozark region are the following counties that may be regarded as the greatest fruit-producing sections: Barry, 410,896; Green, 501,213; Howell, 474,560; Laclede, 258,970; Lawrence, 234,-232; MacDonald, 243,620; Newton, 289,-159; Texas, 291,575; Webster, 624,628; Wright, 351,922.

In other parts of the state are several counties in which apples are grown for commercial purposes, such as Crawford, 270,309; Dent, 240,119; Jackson (in which Kansas City is located), 326,696; Lafayette (adjoining Jackson on the east), 217,441; Livingston, 203,092; Macon, 221,735; Vernon, 200,936. This last named is on the west side of the state toward the south, and may be regarded as part of the Ozark region.

The counties producing the largest number of trees are: Howell, 424,269 bearing trees; Oregon, 463,609; St. Louis, 429,283. The total number of apple trees is 14,359,673; peaches and nectarines, 6,-558,034; pears, 606.973; plums and prunes, 917,851; cherries, 622,332; grapes, 3,-026,526 vines; strawberries, 9,048 acres; blackberries and dewberries 5,975 acres; nuts, 153,244 trees.

For further information see *Ozarks*.

GRANVILLE LOWTHER

Frost and Precipitation in Missouri

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Oregon	Oct. 10	Apr. 26	Sept. 13	May 20	36.8
Suplatte	Oct. 4	May 2	Sept. 13	May 31	43.7
Brunswick	Oct. 20	Apr. 13	Sept. 29	May 1	38.2
Kansas City	Oct. 24	Apr. 7	Sept. 30	Apr. 23	36.4
Marshall	Oct. 10	Apr. 14	Sept. 13	May 1	36.8
Columbia	Oct. 14	Apr. 14	Sept. 28	May 6	38.1
Mexico	Oct. 13	Apr. 19	Sept. 13	May 21	38.2
Harrisonville	Oct. 18	Apr. 13	Sept. 29	May 1	37.5
St. Louis	Oct. 29	Apr. 4	Sept. 30	May 22	37.1
Oakfield	Oct. 25	Apr. 15	Sept. 30	May 14	40.0
Lamar	Oct. 18	Apr. 14	Sept. 15	May 6	41.1
Ironton	Oct. 1	Apr. 25	Sept. 13	May 23	45.3
Springfield	Oct. 18	Apr. 16	Sept. 30	May 19	43.6
Olden	Oct. 20	Apr. 12	Sept. 18	May 1	41.4
Poplar Bluff	Oct. 17	Apr. 13	Sept. 29	May 19	46.7
Sikeston	Oct. 19	Apr. 7	Sept. 30	May 1	45.2

Production of Fruits in Missouri

Small fruits: 1909 and 1899. The next table shows data with regard to small fruits on farms.

Strawberries were by far the most important of the small fruits raised in Missouri, with blackberries and dewberries ranking next. The total acreage of small fruits in 1909 was 17,009 and in 1899, 14,860, an increase of 14.5 per cent. The production in 1909 was 23,696,000 quarts, as compared with 21,485,000 quarts in 1899, and the value $1,761,000, as compared with $1,051,000.

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	....	17,009	14,860	23,696,221	$1,761,409
Strawberries	13,429	9,048	7,498	15,171,034	1,122,784
Blackberries and dewberries	22,971	5,975	4,441	6,391,209	456,283
Raspberries and loganberries	5,631	1,331	1,660	1,563,527	133,196
Currants	1,672	92	194	91,267	8,312
Gooseberries	9,091	555	731	470,029	39,941
Cranberries	103	8	....	6,944	618
Other berries	39	(1)	336	2,271	275

[1] Reported in small fractions.

Orchard fruits, grapes, nuts, and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts, and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910: Farms reporting	Trees or Vines of bearing age 1910: Number	Trees or Vines not of bearing age 1910: Farms reporting	Trees or Vines not of bearing age 1910: Number	Product 1909: Quantity[1]	Product 1909: Value	Product 1899: Quantity[1]
Orchard Fruits, total	....	23,128,107	....	5,748,159	11,957,399	$6,582,578	6,805,501
Apples	181,396	14,359,673	75,035	3,624,833	9,968,977	4,885,544	6,496,436
Peaches and nectarines	152,632	6,588,034	42,896	1,404,429	1,484,548	1,110,550	61,006
Pears	72,255	606,973	29,257	272,213	142,547	148,789	58,449
Plums and prunes	92,163	917,851	23,053	183,828	234,872	211,472	111,603
Cherries	81,863	622,332	29,371	247,425	123,314	222,510	62,708
Apricots	5,730	16,503	1,913	5,612	1,280	1,604	583
Quinces	3,201	16,686	1,550	9,815	1,813	2,063	(2)
Mulberries	23	55	2	4	48	46	(2)
Unclassified	......	....	....	....	....	....	[3] 14,716
Grapes	75,888	3,026,526	14,582	486,044	17,871,816	488,755	13,783,656
Nuts, total	....	[4] 153,244	....	[4] 26,526	[4] 2,823,368	[4] 39,746	1,747,520
Persian or English walnuts	86	1,214	48	999	5,791	618	......
Pecans	1,060	48,822	298	7,214	147,420	10,467	75,170
Black walnuts	2,886	85,330	407	15,199	2,446,402	24,526	(2)
Hickory nuts	419	16,799	38	2,581	210,228	3,633	(2)
Unclassified	......	....	....	....	......	....	[3] 1,672,350
Tropical Fruits (Japanese persimmons)	17	318	3	213	140	200	....

[1] Expressed in bushels for orchard and tropical fruits and pounds for grapes and nuts.

[2] Included with "unclassified."

[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."

[4] Includes almonds, Japanese walnuts, butternuts, filberts, chestnuts, chinquapins, hazelnuts, beechnuts and other nuts.

The total quantity of orchard fruits produced in 1909 was 11,957,000 bushels, valued at $6,583,000. Apples contributed about five-sixths of this quantity, peaches and nectarines most of the remainder. The production of grapes in 1909 amounted to 17,872,000 pounds, valued at $489,000, and that of nuts to 2,823,000 pounds, valued at $40,000. Most of the nuts were black walnuts.

The production of all orchard fruits together in 1909 was 75.7 per cent greater than in 1899, and the production of grapes also increased. The total value of orchard fruits increased from $2,944,000 in 1899 to $6,583,000 in 1909, and that of grapes from $315,000 in 1899 to $489,000 in 1909. It should be noted in this connection that the values for 1899 included the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	14,707	5 3	Gals...	1,065,881	930,668
Vinegar	10,453	3.8	Gals.......	402,518	316,575
Wine and grape juice.	5,413	2 0	Gals... ..	245,656	122,382
Dried fruits	15,753	5.7	Lbs........	1,102,274	1,327,660

Mites or Red Spiders. See under *Apple*.

Moisture, Conservation of. See *Soils*.

Montana

Montana, the third state in size in the United States, has 146,000 square miles or 93,491,200 acres. Of this amount 26,000,000 acres is classed as mountain land, too rough for agricultural purposes and valuable mostly for mining; 38,000,000 acres is grazing land, and 30,000,000 acres farming land, some of which can be irrigated, and small strips of which are adapted to fruit growing. The mountain ranges are part of the Rocky mountain system and include the Bitter Root mountains, Kootenai, Cabinet, Mission, Tobacco Root, Snow Crest, and others.

The western part of the state is drained by the Bitter Root, the Missoula, the Flat Head, the Kootenai, and other tributaries of the Columbia river; the eastern part is drained by the Yellowstone and Missouri with their small tributaries. Mount Stimpson summit of Glacier park is peculiarly distinguished by the fact that its waters drain into three oceans; toward the north, through the St. Marys and the Belly rivers, its waters drain into the Arctic ocean; toward the west, through the Columbia, into the Pacific; and toward the east, through the Missouri, into the Gulf of Mexico and Atlantic ocean.

The Bitter Root valley is perhaps the oldest fruit-growing section in the state, and at the present time is believed to be the best. Apples, pears and plums are grown and are exceptionally fine in size and flavor. Some varieties of cherries, grapes and peaches do well if locations are wisely chosen. This valley is in the southwestern part of the state and is about 75 miles long by 10 in width. It has an altitude of 3,200 to 4,500 feet.

Montana has much waste land, yet without question is great in her possibilities of mining, agriculture, horticulture, and stock growing.

Bitter Root Valley Taken from East Side of Valley Looking West.

Bitter Root Valley Fruit Growing

R. W. Fisher

The Bitter Root valley is situated between the Bitter Root mountains on the west and the Hell Gate range of the Rocky mountains on the east. The Bitter Root mountains have an average height of about 8,000 feet, and as a general rule the snow is gone from the mountains by July 15 or August first, except on the north slopes far back in the canyons. In these canyons snow and small glaciers provide the water for late irrigations. The east-side mountains are not nearly as high and have but little snow to furnish irrigation water.

The altitude of the valley varies from 3,198 feet at Lolo in the northern end of the valley to 3,888 feet at Darby in the southern end. The Como orchards west of the town of Darby are several hundred feet higher, or in the neighborhood of 4,000 feet above sea.

The valley ranges in width from a few hundred yards to 10 or 12 miles, none of the tillable land being very far from the mountains on either side. A large portion of the tillable land is on the benches sloping from the mountains, thus affording good air drainage. The larger portion of the tree acreage is on these bench lands where the slope is sufficient to give both air and water drainage, while the best grain land is on the bottom, where air drainage is not so important. The lands may be divided into three general classes, in regard to situation: First, bottom land, or lands near the level of the river; second, upland bottoms, or lands that are comparatively level, but several hundred feet higher than the river bottom land; and third, the bench land that is higher than the river bottom and has a considerable slope.

The river bottom land is poorest for orchard purposes, both because of frosts and water seepage. Some of the upland bottoms are well adapted to growing fruits. Such land is usually situated in the mouth of a canyon, where the soil is rich in plant food elements, and usually has a night wind from the canyon which has considerable influence in preventing frosts. As a general rule the bench lands are the best fitted for profitable fruit growing, because of better air and water drainage.

See article on *Frost*.

Early fall and late spring frosts are much more likely to occur on the river bottom land. The frosts on the upland bottoms depends much upon the location of the land in regard to nearby canyons, while the bench land as a general rule is particularly free from injurious frosts at any time.

Except near the mouth of the numerous canyons coming out of the Bitter Root mountains, the general wind direction is from the south or southwest. During the winter months the cold winds come from the north or northwest, but have little influence upon the growth of trees or production of fruit.

Tables giving monthly mean maximum and minimum temperatures, also dates of last killing frosts in spring and first of autumn, also monthly maximum and minimum temperatures, all from Hamilton, follow:

Dates of Last Killing Frosts of Spring and First of Autumn at Hamilton, Mont.

1903	May 22	Sept. 14	1907	May 25	Sept. 18	1911	May 28	Sept. 23
1904	May 25	Oct. 5	1908	April 30	Sept. 26	1912	....	....
1905	May 18	Oct. 9	1909	May 8	Sept. 23	....	....	....
1906	May 6	Sept. 15	1910	June 3	Aug. 24	....	....	....

Monthly Mean Maximum and Minimum Temperatures at Hamilton, Mont.

	January		February		March		April		May		June	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1903..	3.78	22.2	34.0	17.0	45.8	26.1	58.6	31.0	67.4	36.0	77.0	47.8
1904..	40 9	23.8	41.6	23 7	44.2	23.5	63.8	34.5	67.4	40.0	73.4	42.3
1905..	33.0	17.4	36.2	11.0	52.6	29.6	61.1	35.8	68.6	39.7	70.2	43.7
1906..	b41.1	21.9	44.8	22.6	41.6	19 4	63.8	35.1	64.6	41.2	70.2	43.6
1907..	23 6	4.3	41.4	21.2	48.0	28.1	58.5	31.2	65.7	37.0	67.2	44.1
1908..	38 2	18.7	45 2	23 5	49.8	27.5	62.2	34.3	60.5	39.3	66.0	42.9
1909..........	31 9	13 2	44.1	26.3	51.9	27.2	a54.4	a31.3	64.4	38.4	74.6	46.8
1910..........	36 9	13 9	37.3	14.5	61.6	32.1	70.7	38.2	71.9	41.6	78.1	46.8

	July		August		September		October		November		December	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1903..........	77.1	46.8	80.5	49 4	67.2	40.9	a57.5	33.4	38.9	19.2	36.9	17.9
1904......	80.8	49.7	81.5	50.6	74.1	44.0	a61.0	36.9	52.3	29.3	a40.6	21 0
1905....	83.0	51.0	80.6	50.9	......	......	....	....	d46.5	20.2	....	16.6
1906......	85.8	53.8	79.3	50.8	73.1	42.6	60.9	34.3	b46.2	f28.2	....	....
1907.........	78.0	48.6	74 5	46.5	....	41.2	61.5	37.5	51.8	27.3	d38.7	d19.1
1908..........	82.6	49.8	i78.8	b49 7	b72 9	45.9	54.5	33.9	b45.1	b27.3	a35.0	a18.4
1909 .	80.0	50.1	84.6	48.3	f69 8	45.0	61.5	33.7	51.3	29.9	34.1	15.0
1910..........	85.4	52.6	77.5	47.3	64.3	42.8	61.9	37.2	43.6	29.2	35.1	20.1

a 1 day missing. b 2 days missing, etc.

Monthly Maximum and Minimum Temperatures at Hamilton, Mont.

	January		February		March		April		May		June	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1903..........	54	7	49	-2	66	6	77	20	90	18	89	41
1904..........	52	10	52	8	56	1	80	26	81	28	87	30
1905	52	-8	65	-28	68	15	74	25	85	30	83	37
1906..........	57	7	60	9	70	-13	83	25	83	24	84	34
1907	46	-18	57	..	64	17	73	17	83	25	82	35
1908	49	-9	64	-9	66	9	79	23	80	34	85	33
1909 .	56	-33	55	6	64	10	65	15	80	25	93	37
1910.........	57	-23	51	-26	73	20	89	26	85	30	97	30
1911	48	-12	42	3	69	2	71	23	83	30	85	36
1912	56	-7	50	11	61	4	75	25	79	31	92	40

	July		August		September		October		November		December	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1903..	94	38	94	40	81	28	71	20	65	-6	57	9
1904..........	93	39	93	37	84	33	79	27	60	21	54	-10
1905	94	42	89	40	86	32	77	11	60	-9	....	3
1906.	93	46	92	45	85	32	78	21	60	-8	....	....
1907.	90.9	38	88	38	...	30	70	31	68	17	50	d-10
1908.	96	38	i 93	b 37	b 89	b 29	72	23	b 70	b 8	a 51	a 1
1909..........	91	41	91	36	83	32	68	20	70	3	51	-8
1910..........	95	43	90	32	74	29	77	20	64	9	49	9
1911..	93	39	90	40	82	29	70	16	57	-3	54	-15
1912	89	41	90	35	74	29	73	21	61	13	......	.. ..

a 1 day missing. b 2 days missing etc.

It is reported that the United States Weather Bureau Service is to locate several frost-warning stations in the valley which will be of much assistance to fruit growers. Because of the comparatively high altitudes and light atmosphere, smudges and frost pots probably will not have the same value as they do in lower altitudes. The heat from smudge pots and smoke from smudges has a tendency to rise too rapidly for the most beneficial results. Smudges or frost pots have not

been used in any commercial extent in this valley, although they may at times be of great value in preventing losses, especially to cherry crops and other tender kinds of fruit.

Humidity

The following table gives the monthly precipitation for the period 1903 to 1912 inclusive:

Monthly Precipitation for Hamilton, Mont.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1903.	1.08	0.46	0.45	0.67	0.70	1.41	0.87	0.72	0.96	1.00	0.63	0.22	8.77
1904	0.07	0 41	1.26	0.68	1.31	0.67	0.18	0.24	0.26	1 29	0.40	0.97	7.74
1905..	0.17	0.30	0.51	1.21	0.84	2.37	0.38	0.27	0.43	0.33	0.53	0.35	7.69
1906..	0.99	0.66	0.99	1.00	2.37	1.24	0.50	1.45	1.04	0.72	1.60	1.50	14.42
1907	1.51	0.93	1.03	0.44	0.46	4 35	0.62	1.51	1.07	0.37	0.40	0.99	13.68
1908	0.43	0.16	0.93	0.90	3 83	2.62	0.88	1.10	1.43	1.10	0.07	0.03	13.48
1909..	3.69	0.41	1.01	1.50	0.84	1.85	2.45	0.17	1.99	0.48	1.86	0.33	16.58
1910..	0.93	2.24	0.74	0.20	1.19	0.59	1.05	0.80	3.35	1.26	2.11	0.49	14.95
1911..	1.01	0.23	0.00	1.16	0.76	2.99	0.87	1.62	1.90	1.99	1.05	0.53	14.11
1912.	0 51	0.37	0.23	2.38	3.53	0.55	1.28	1.18	1.10	0.63	1.22	....	....

It will be noted that the most rain falls during the months of May and June, or during the rapid growing season, and while the rainfall is not sufficient for crop production, these spring and summer rains are a great help in the work of irrigation.

Precipitation records have been kept at one place only—Hamilton—for a period long enough to warrant drawing any conclusions. It is known, however, from general observation that there is much difference in the rainfall in different parts of the valley, being less on the east side of the valley than on the west side, and being less farther away from the mountains than near the mountains or on the foothills.

Considerable more snow falls on the west side of the valley and it lies on the ground longer than on the east side. In fact there is usually very little snow on the east side of the valley at any time.

Soils

Most of the orchard land on the west side of the valley is cut-over timber land. This land was formerly covered with merchantable timber, mostly Western yellow pine, which has been logged off and sawed into lumber. The cost of clearing such land varies from $25 per acre to $50 or $75, according to the amount of tree stumps to be removed.

The soil is a decomposed granite, and where the rocks are entirely decomposed makes a very rich and substantial orchard soil.

One can find clay, loam, sandy loam, gravel and soils so rocky that it is impossible to plow them. Chemical analyses show that these soils are well supplied with all elements of plant growth, but in places the soil is much benefited by an application of lime.

The east-side land was formerly a sagebrush country, and in past years has provided pasturage for an enormous number of sheep. The land is more of a volcanic origin, and rough-edged rocks and stones are found on most of the soil. The cost of clearing land of sage brush is much less than the stump land on the west side, the cost ranging from a few cents per acre up to $3 or $4. In cases where the land is covered with many rocks the cost may be as much for clearing as the stump land of the west side free from rocks.

An analysis of a typical east-side soil shows that it contains—

	Per Cent
CaO or lime..........................	.755
K^2O or potash..........................	.4725
P^2O^5 or phosphoric acid................	.09
Nitrogen	.81

Assuming that the weight of eight acre-inches of soil, that being the depth of soil from which the above analysis was made, is 2,375,000 pounds, the analysis shows that there is 17,931 pounds of lime, 11,220 pounds of potash, 2,137 pounds of phosphoric acid and 1,947 pounds of nitrogen in each eight acre-inch of soil.

The food elements removed by bearing apple trees during a period of 20 years have been estimated to be:

	Nitrogen	Phosphoric Acid	Potash
Apples	498.6	38.25	728.55
Leaves	456.75	126.	441.
Trees	283.15	107.47	264.25
Total pounds..	1,238.5	271.7	1,433.8

If trees were able to remove all the plant food elements from the soil (which they are not) there would be enough nitrogen, in the soil analyzed, to last a fruit crop 30 years; enough phosphoric acid to last 150 years and enough potash to last about 160 years. The above analysis was from the top eight inches of soil, and since fruit trees gather food to a much greater depth, it is evident that there would be much more of the plant food elements per acre than is indicated above. However, plants cannot take all the elements from the soil for many reasons, chief among which is the fact that a large portion of the elements in a soil are unavailable for plant use until made so by proper tillage, application of humus and other means.

On the sage-brush benches of the east side there is but little humus in the soil, and through continuous clean cultivation what humus there is is soon worn out and the soils become hard and compact and a poor place to grow profitable crops of fruit.

Within the past few years much thought and study has been given to the subject of getting humus into the soil in order that the plant foods therein may be made available, to loosen the soil and put it into condition to take up and retain moisture, and to make it possible for the soil bacteria to work, which is very essential to the best growth of plants.

The application of barnyard manure would accomplish these things, but in the large acreage planted to trees this is impossible to do. Field peas, clover, alfalfa and other legumes are now being planted and plowed under as green manures with very beneficial results.

Field peas are planted in the spring as early as germination can take place, and are usually in condition to plow under by July 15. The clovers are planted in the spring with some nurse crop and are grown until the summer or fall of the second year. When clover is planted among young trees there is an appreciable check to the growth of trees during the time the clover is growing, and the soil needs much more water than when in clean cultivation. After the clover is plowed under the trees take on a new growth and will soon look as vigorous and thrifty as

Young Apple Orchard in the Bitter Root Showing Clean Cultivation.

before. Winter vetch has been grown in a few orchards and promises to be a valuable plant to grow as a cover crop, planted either in the spring and plowed under in July or August, or planted in the fall and plowed under the following spring or summer. Alfalfa as a cover crop is not being grown on a large acreage because it is very hard to plow under in the orchard and get the land back into clean cultivation.

The annual or biennial crops offer the best plants for orchard cover crops, as most of them produce a large amount of humus and are easily worked into the soil.

Irrigation

Practically all orchards are irrigated by what is known as the furrow system, with from one to four or five furrows between the tree rows. These furrows are usually not more than one-fourth mile long and even shorter furrows will accomplish a better distribution of water. Much depends, however, on the character of the soil being irrigated. The water is run through the furrows from a few hours to 24 or sometimes as long as 48 hours, depending upon the character of the soil in downward and lateral seepage from the furrows.

In clean cultivated orchards where the soil moisture can be conserved by a dust mulch, one or two irrigations are usually sufficient to grow a crop. Where cover crops or even intertilled crops are grown it is sometimes necessary to irrigate three or more times during a season. Old bearing orchards also require more water than young orchards that have not come into full bearing. There is but little seepage from underground water on the benches and practically no drainage has been done on the bench lands. On some of the bottom orchard land underground water has come to the surface and has caused such land to be drained before profitable fruit crops could be grown. The injury from seepage is likely to increase as more of the bench land is put under irrigation and the land has been irrigated for a longer time than it has at present.

The natural water table on the east-side benches ranges in depth from 10 or 15 feet to 200 or 300 feet, and from the rather rapid slope of the bench lands underground water is not likely to damage the fruit lands.

Kinds and Varieties of Fruit Crops

Apples, pears, plums, cherries, prunes and other hardy deciduous fruits have been profitably grown, while the hardy bush fruits grow and produce in great abundance.

Of the apples the McIntosh is probably the most profitable variety grown and surely the most generally planted variety. The Jonathan, Delicious, Rome Beauty, Gano, Wealthy and a few other varieties are being grown in commercial quantities.

Up until a few years ago a large acreage of Transcendent crabapples was planted and they were very profitable. Because of the susceptibility of this variety to apple or pear blight it is not advisable to plant this variety, and many of those now planted are being removed and replaced with more resistant varieties.

The sweet cherries most planted are Bing and Lambert, with Black Republican or Black Tatarian for pollenizers. The sour cherries most generally planted are Early Richmond, English Morello, Late Duke and Montmorency.

The pears most generally planted are Bartlett, Flemish Beauty, Clapp's Favorite and Anjou.

Most varieties of plums and prunes grow well ana produce abundantly, but because of market conditions are not grown in commercial quantities. There are no drying or evaporating plants in the valley and a restricted market prevails for all tender fruits.

Strawberries and bush fruits grow in great profusion and are profitable commercial crops.

Because of winter weather conditions almost all trees are planted in the spring on land that has been plowed the previous fall or in the early spring. The planting season usually begins by March 15 and may be continued until as late as May 1, although the early planting is rec-

ommended. Water is usually put in the holes with the trees if the planting is late. Most of the orchards recently planted are laid out in the hexagonal or triangular system, the trees being from 24 to 30 feet apart.

In young orchards most of the pruning is done during the late dormant period, during the months of March, April and early May. The general practice is to cut out the leaders and grow the open-centered tree. The trees are headed from 18 to 24 inches from the ground and made to branch as low as possible for easy and efficient cultivation under the trees.

Wind breaks have not been planted in the valley to any great extent, and except in the most exposed places are not required for the successful growing of fruit crops.

The chief fruit pests now in the valley are: On apples, blight, aphis, bud moth, scab and nursery diseases such as crown gall, etc.; on pears, blight and blister mite. Cherries are particularly free from all insect and fungous diseases, the greatest damage being done by gummosis. The sweet cherries, Bing and Lambert, are sometimes injured by late spring frosts or during a very severe winter, although as a general rule frosts or freezes do not affect the cherry tree or crop.

Frost and Precipitation in Montana

Station	No.	Frost				Precipitation
		Average Date of		Date of		
		First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Kipp	1	Aug. 26	....	Aug. 3	July 21	18.5
Havre	2	Sept. 18	May 17	July 28	....	14.2
Kalispel	3	Oct. 10	May 5	Sept. 26	May 23	16.4
Glasgow	4	Sept. 5	May 26	Aug. 11	June 20	11.8
Poplar	5	Sept. 11	May 16	Sept. 3	June 26	13.1
Great Falls	6	Sept. 24	May 1	Sept. 9	May 20	13.4
Missoula	7	Sept. 5	May 30	Aug. 1	June 20	15.5
Glendive	8	Sept. 22	May 10	Sept. 11	June 9	15.9
Helena	9	Sept. 24	May 11	Sept. 5	June 9	13.3
Butte	10	Sept. 15	May 29	Sept. 6	June 25	12.2
Miles City	11	Oct. 9	May 1	Sept. 7	Nov. 9	12.5
Crow Agency	12	Sept. 18	May 18	Sept. 7	June 21	13.6

For additional information on orchard sites and soils, see *Selection of Site*, under *Apple Orchard*.

Fruit Production in Montana

Small Fruits: 1909 and 1899. Strawberries are by far the most important of the small fruits raised in Montana, with raspberries and loganberries and currants ranking, respectively, second and third. The total acreage of small fruits in 1909 was 562 and in 1899, 554, an increase of 1.4 per cent. The production in 1909 was 767,000 quarts, as compared with 1,034,000 quarts in 1899, while the value was $86,586 in 1909, as compared with $79,891 in 1899.

The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	....	562	554	766,791	$86,586
Strawberries	619	265	281	406,038	46,870
Blackberries and dewberries	129	34	18	36,321	4,020
Raspberries and loganberries	361	113	80	165,473	19,732
Currants	654	115	120	123,031	12,195
Gooseberries	350	35	51	35,896	3,765
Cranberries	1	(1)	....	32	4
Other berries	.....	....	4	....	....

[1] Less than 1 acre

Orchard Fruits, Grapes and Nuts: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product 1909		Product 1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	...	749,104	...	1,363,798	591,088	$609,078	45,192
Apples	3,167	696,753	3,633	1,308,066	567,054	566,938	43,939
Peaches and nectarines	49	538	117	3,386	128	235	17
Pears	586	10,297	663	12,806	7,543	12,008	24
Plums and prunes	948	21,140	1,072	15,001	8,777	11,642	373
Cherries	1,013	19,938	1,197	24,237	7,497	17,985	807
Apricots	36	410	60	245	88	269	1
Quinces	5	28	12	54	1	1	(2)
Mulberries		..	1	3	....	....	(2)
Unclassified			.....	....	....	....	[3] 31
Grapes	13	986	49	1,121	370	17	1,330
Nuts	.	[4] 23	....	[4] 272	....	....	....

[1] Expressed in bushels for orchard fruits and pounds for grapes.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes hazelnuts, black walnuts, almonds, hickory nuts, butternuts, chestnuts and filberts.

The total quantity of orchard fruits produced in 1909 was 591,000 bushels, valued at $609,000, apples contributing more than 95 per cent of this quantity. The production of grapes and of nuts in this state is unimportant.

Mountain Ash. See *Apple, Botany of.*

Mulberry

The mulberry belongs to the genus *Morus*, the order *Moraceae*. About 100 species have been catalogued, but only five are now generally grown. The mulberry belongs to the same family as figs, bread-fruits, elms, etc.

The Moraceae include three sub-families, of which the typical genera are: Dorstenia, which is almost a fig; Broussonetia, the paper mulberry of Japan, the East Indies, and the South Sea Islands, and Morus, the mulberry proper, of which the few species now catalogued are all native to the temperate regions in Asia and America, or to the mountain regions in the tropics, but are readily cultivated in similar climates in Europe, Africa and Australia.

In the Old World various species are of economic importance, principally because their leaves supply the food of the silk-

McIntosh Red
This Apple Does Especially Well in the Bitter Root Valley and Is the Principal Variety Grown There. (See p. 1366.)

worm. Their fruit may be used for wine and dessert. The wood of the red mulberry is fine grained, strong and useful for building purposes.

GRANVILLE LOWTHER.

Varieties

From the standpoint of fruit production the North Carolina Station recommends the following varieties for planting about the farm. New American, Black English, Stubbs and Townsend of the black-fruited varieties, and White English and White Russian of the white-fruited sorts. Of the New American, Professor Bailey, in an early bulletin of the Cornell station, states that it is the best sort known for the Northern states. The tree is a hardy, vigorous grower, productive, and bears continuously from late June until September. Large trees will produce 10 bushels of fruit in a season. The fruit varies in length from one to two inches and is a glossy black when ripe. It is frequently sold for the Downing, but is superior to that variety.

The Black English is considered by Hume and Reimer as one of the most satisfactory varieties for planting in North Carolina. The tree is a strong upright grower, and bears a large amount of fruit of medium size from May to July. The flavor is sweetish and the quality only fair. The Townsend is considered by the same authors as the earliest fruiting variety now grown, ripening in Florida from the latter part of March through April. The trees are very prolific, fruiting abundantly in the nursery row one year from grafting. It is of medium size, 1 by ½ inch, black, with a sweetish flavor not differing from other mulberries.

The Stubbs is a wide-spreading, vigorous, prolific variety. The fruit is very large, varying from 1½ to 2 inches in length and from ½ to ⅝ inch in diameter, with a bright deep-red color, becoming black, subacid, and of excellent quality. The ripening season in North Carolina is from June to August.

Of the white-fruited varieties recom-

mended by the North Carolina station, White English is considered by far the best. It is a heavy bearer, producing sweet, medium-sized fruits of good quality from May to July. The White Russian seems to be a small, bushy, very hardy sort, and quite productive. The fruit is of medium size, white, very sweet and of fair quality. The season is from May to June.

Varieties for Northwest

In the West and Northwest the Russian mulberry *(Morus alba* var. *tartarica)* has proved excellently adapted for planting in shelter belts and hedges and also for fence posts and fuel. This variety is very hardy against both cold and drought and makes a splendid growth there. It is the species commonly used there as a stock on which to propagate the more fruitful varieties. The Russian mulberry possesses particular merit as a hedge plant in cold regions from an ornamental standpoint. There is also a number of ornamental forms of the mulberry, including weeping sorts, which are extensively used in ornamental plantings.

Propagation

In propagating the plant for use in hedges or shelter belts the plants are grown from seeds, but for fruit purposes grafting, cutting or layering must be resorted to in order to produce varieties true to name.

Most species of mulberries are easily propagated by means of cuttings. And while the most satisfactory and most economical plan is to use one-year-old branches for this work, twigs of the current season's growth may also be used. Cutting wood may be removed from the trees soon after the leaves have dropped. Select well-matured, well-developed one-year-old branches from one-quarter to five-eighths inch in diameter. Cut these into pieces, each being provided with from three to six good buds. In Eastern North Carolina the cuttings may be planted immediately after removal from the trees, but in the colder sections it is usually best to tie them together in bunches of 25 and store them in damp sand in a cellar or pit until spring.

The cuttings are set out in well-prepared soil, making an opening in the ground with a spade, firmly pressing the soil about the base of the plants and covering up to the top bud. It takes longer to produce trees by this method than by budding or grafting. Bench grafting by either the whip, cleft or saddle method is used; or the trees may be grafted out of doors, using either the cleft or whip method. In the South, Multicaulis mulberry stem or root cuttings are used almost exclusively as stocks, while in the colder West and Northwest, Russian mulberry seedlings are used as stocks.

In the orchard large-growing trees like New American, White English and Black English should be planted about 30 feet apart, and for such varieties as Stubbs and Hicks 35 feet in the row is close enough between trees. The trees should be set out in the usual manner by cutting off all broken and bruised roots, shortening in the longer roots somewhat and cutting back the top.

*According to Hume and Reimer the mulberry needs little or no cultivation. When planted in chicken yards or where hogs are allowed to run and root no extra cultivation need be given. They will thrive in soddy land, but generally the trees do better where the soil is stirred or worked, as in hog pastures. If any cultivation is given it should be shallow, as the roots spread out near the surface of the ground. Deep plowing should not be practiced. The mulberry requires little or no pruning. But as the wood is rather brittle and the branches are easily broken by sleet storms, the stubbs which are left should be cut off close up to the trunk and the broken branches cut smoothly off at the ends.

Wild mulberries have been used since the earliest times in America. Hariot, in his Narrative of the First Plantation of Virginia, which was first printed in 1588, mentions that the Indians used mulberries, crabapples and huckleberries, such as were known in England; but the mulberry has occupied a less important place

* Office of Experiment Stations, U. S. Department of Agriculture, in Farmer's Bulletin No. 276.

in the list of foods than most other edible native fruits and berries. The quality of the wild fruit is known to vary greatly, some trees yielding berries of excellent flavor and appearance while others produce small and very inferior berries. The fruit of cultivated and improved varieties of mulberries is much superior to the native fruit and has been long appreciated though never common in the United States. Old gardens in Eastern and Southern states and New England often contain a mulberry tree and the fruit has been used in a limited way for the table and for preserving.

In flavor and appearance, mulberries, particularly the dark varieties, resemble blackberries more nearly than they do any of the other common fruits. The flavor is sweet and rather aromatic, though not as pronounced as that of the blackberry, and to some palates it is always accompanied by a suggestion of the peculiar and elusive odor noticed when mulberry leaves are crushed.

The color of the dark-fruited varieties is intense, and as the berries are soft and easily crushed, they stain the fingers or table linen very readily.

According to analytical data reported some years ago by a German investigator cultivated mulberries contain 84.7 per cent water, 0.4 per cent protein, 14.3 per cent carbohydrates and 0.6 per cent ash. According to American analyses, blackberries, on an average contain 86.3 per cent water, 1.3 per cent protein, 1 per cent ether extract, 10.9 per cent carbohydrates and 0.5 per cent ash, values which in general are much like those quoted for mulberries. In the case of blackberries about 6 per cent of the total carbohydrates has been found to be invert sugar, and in the case of mulberries about 9 per cent. Of course, the kind and amount of sugar would be influenced very greatly by the degree of ripeness.

Mulberries can be used as a dessert fruit and also for making pies, puddings, jellies, jams, etc., in the same way as more common berries. The expressed juice is bottled to some extent in Europe, like raspberry juice and other fruit juices, and mulberry wine is also made. The long fruiting season and the generous yield are points in favor of the mulberry for table use.

MULBERRY PESTS

Cottony Maple Scale. See *Apple Pests.*

Ivy or Oleander Scale. See *Apple Pests.*

Soft Brown Scale
Coccus hesperidum Linn.

General Appearance

Oval, flat, soft scale, varying from straw to dark brown color; often with distinct darker markings. The largest attain one-fourth of an inch or over in length and three-fourths as much in width.

Life History

The young are born alive in great numbers. The male scales are many times smaller than the females and much lighter in color. All stages are bark and leaf feeders. On citrus trees they crowd in such numbers as to overlap on the younger limbs and the mid-ribs of the leaves. The life cycle covers from three to five months.

Distribution

A serious pest to many plants and very troublesome in greenhouses.

Food Plants

Citrus, oleander, camelia, clematis, morning-glory, holly, ivy, laurel, box elder, myrtle, jasmine, mulberry.

Control

Same as for black scale. See *Olive.*

Natural Enemies

Internal parasites contribute to hold this pest in check but remedial measures are nearly always necessary wherever it appears.

E. O. Essig

White Peach Scale. See *Peach Pests.*

Mulches, Effects of. See *Soils.*

Mushrooms and Toadstools

W. A. Setchell

What is a toadstool? The answer of the botanist is that a toadstool is any one of the fleshy umbrella-shaped fungi which commonly are called by that name or by the name of "mushroom." The popular desire, however, seems to be to restrict the name "toadstool" to the poisonous species and that of "mushroom" to the edible species. This is, however, very unsatisfactory, since one cannot tell, except by trial, whether a particular toadstool is poisonous or not.

Edible, innocent and poisonous toadstools.

A few toadstools are extremely poisonous, a considerable number are probably slightly poisonous, most toadstools are innocent, i. e., not poisonous, and some of the innocent species are edible. Edibility implies that only those innocent species which are of fair size, sufficiently delicate texture and of agreeable flavor are to be included in the list.

How may one tell an innocent from a poisonous toadstool? The popular mind always seeks some test which may be applied. Such a test should, of course, be decisive and of uniform result. Many reputed tests pass current and are implicitly believed in by some. So far as is known there is no single test, short possibly of chemical analysis, which will give results of any value whatsoever! It may be well to mention some alleged tests in order to emphasize their unreliability and their danger.

Unreliable Tests

1. The so-called "silver test" is one most prevalent. It is believed that a silver spoon or coin placed with the toadstools while cooking will demonstrate by blackening or failure to blacken whether the toadstools are safe to eat or not. It need only be said in criticism that there are both poisonous and innocent species which act alike on silver. This test is therefore of no value.

2. Some say that if the outer (upper) skin of the top of the toadstool peels off readily, such a species is edible. It may be said that certain edible species will "peel" and other edible species will not "peel." Some poisonous species also will "peel." So there is no reliance to be placed on this "test."

3. It is alleged that edible toadstools while raw have an agreeable flavor when tasted (in minute quantities as a rule), while poisonous species are bitter or peppery, or even disagreeable in flavor. Some disagreeably flavored toadstools are innocent and even of agreeable flavor when cooked, while some others are looked upon with suspicion and reputed poisonous. The most poisonous toadstools, however, are, at least, not at all disagreeable as regards the flavor of the raw flesh. Consequently, this test offers no certain way to distinguish poisonous from innocent or edible toadstools.

4. When one breaks open a toadstool or bruises it, it may change color or it may not. Sometimes the change is to light or to dark blue, sometimes to a reddish or brownish tint of darker or lighter hue. This may or may not be significant, but it is no reliable test of a general character. In general, any decided change of color should arouse suspicion, but the lack of it gives no indication whatsoever as to the nature of the toadstool.

5. Some toadstools when broken open show a milky juice. This is usually white but may be red, orange or blue. Some such toadstools are regarded as poisonous, others are well known to be innocent, and some are delicious eating. On the other hand the lack of a milky juice is no evidence of either non-poisonous or of poisonous character.

6. Many, if not all, toadstools are liable to be infested by insects, whose larvae are often so abundant within the plant (often without any external evidence of it) that the toadstools are fairly honeycombed by their ravages. Some take this as an indication of a non-poisonous nature on the part of the toadstool. Experience has shown, however, that this is not so, but that the insects attack both poisonous and non-poisonous species.

More Certain Methods

There are, then, no tests to be applied with any certainty and the question still before us is: How may one tell the poisonous from the innocent species? There are two methods:

1. By eating them! This is, however, a tedious process and one attended with more or less danger. It is not to be recommended, especially to the beginner. If tried, the following process is usually recommended. A very small bit of the raw toadstool is chewed but none of the juice swallowed. If after 24 hours no disagreeable result is experienced, a similar bit is chewed and some of the juice swallowed. If after a similar interval no disagreeable symptoms result, a small piece may be chewed and swallowed. If nothing suspicious occurs after 24 or 36 hours, a fair quantity may be tested by cooking and eating. It is proper to warn the novice that this may be done safely only after learning to distinguish the most poisonous species (especially the species of Amanita mentioned later on), since of some of these it needs only a very small piece to produce serious poisonous effects.

2. By learning of the experience of others. There has been accumulated a certain amount of knowledge concerning the innocent or poisonous character of toadstools. While this body of knowledge is not complete, and while there are certain parts of it about which there is lack of agreement, a considerable number of toadstools are well known to be either poisonous or edible. How then is one to avail himself of this knowledge? By studying the toadstools and the various books written on the subject. Much that is reliable and satisfactory may be learned in this way. One must learn to know the various kinds of toadstools as one learns to know the ordinary plants of hill and forest and garden.

What are the distinguishing marks of difference among toadstools?

I. In general, each toadstool possesses an upper flattened horizontal structure which is usually called the "cap," or botanically, the "pileus," and a stalk, botanically called the "stipe." In some cases, the stalk or stipe fits into a swollen cup-like structure at the base which is called the "volva." The presence or absence of a volva is a matter of considerable importance; consequently in studying toadstools one should be careful to obtain the very base. Many toadstools have a sort of ring or collar encircling the stipe somewhere between the base and the pileus.

II. Structures of very great importance are those found on the under side of the cap or pileus. This portion of the pileus is called the "hymenium." By the difference in the structure of the hymenium, toadstools may be divided into four classes, as follows:

1. Hymenium smooth. There are not many toadstools in this group and few of them of a texture sufficiently soft to allow of eating. There are no poisonous species known in this group.

2. Hymenium spiny. These are called "Hedgehog Toadstools or Mushrooms." The species possible of being eaten are few and none of them, so far as is known, is poisonous.

3. Hymenium porose. The hymenium in the toadstools of this group is made up of closely crowded tubes, perpendicular to the horizontal diameter of the pileus, as may be seen by breaking the pileus open. It is the mouths or openings of these tubes which give the surface of the hymenium its porous or spongy appearance. There are many species in this group; some are innocent and some are poisonous. They are all to be avoided by the beginner until he has learned to distinguish them from the descriptions of pictures in the books or has had the distinguishing characters pointed out by one who is acquainted with them.

4. Hymenium made up of "gills." "Gills" are flattened, knife-blade-like structures radiating out from the center of the lower side of the pileus or cap to the circumference. Some extend from the place where the stipe joins the under side of the pileus to the circumference, while shorter ones extend from some point farther out to the circumference.

By far the larger number of toadstools are of this fourth class and are called "Agarics." The Agarics are divided into five subclasses by the color of their spores. In order to determine the color of their spores it is necessary to remove the pileus (which should be fairly young and fresh) from the stipe and place it, hymenium side down, on a piece of paper, preferably of a light gray, brown, or blue. It is also advisable to cover the pileus with a tumbler or dish so as to prevent too rapid drying. In from one hour to several, according to the species, the spores, which are the minute bodies from which the toadstools grow again, will be expelled from the surface of the gills onto the paper in such quantity as to indicate the color. The colors are as follows:

(a) White. The majority of Agarics are in this subclass. Those of this subclass having a cup or swollen bulb at the base accompanied by a ring half to three-quarters up the stipe are to be avoided, for these belong to the species of Amanita and some of them are among the most poisonous of toadstools. Those of this subclass having the solid portion of the pileus thin in proportion to the gills and in which the gills are nearly all of equal length are to be avoided, especially if the top of the pileus is bright colored. Avoid also all of this subclass having a milky juice, unless the juice is reddish. Other white-spored Agarics may be eaten, at least cautiously at first.

(b) Black. Black-spored Agarics are all innocent and especially those in which the gills, when old, change into inky fluid. They are to be eaten, however, before the gills turn black.

(c) Ochre. In these the spores are yellowish or rusty brown. None of the species is reputed poisonous.

(d) Brown. The spores are dark brown or purplish brown. The common mushroom, with gills which are pink changing to purplish black, and with a distinct ring on the stipe, belongs here and is edible, as are most of the species. Some, however, are under suspicion.

(e) Rose or Red. Some of the pink-spored forms are under suspicion, but those with deep-red spores and a volva, but without a ring, are edible.

What to Avoid

1. All toadstools in the young or "button" stage. At this time it is impossible to determine, except after long experience, some poisonous species from some edible species.

2. Avoid all those with pores on the under side of the cap until sufficient acquaintance teaches the difference between edible and poisonous varieties.

3. Avoid all species with gills, white spores, a ring and a volva or bulb-like base. The most poisonous species are in this group.

4. Avoid those having a milky juice unless the milk is red.

5. Avoid those having the cap thin in comparison with the gills, especially if they are bright colored.

6. Avoid all toadstools which are not strictly fresh, since decay sometimes greatly increases poisonous substances. By following these rules implicitly one may avoid the most poisonous kinds, but the novice should experiment with the greatest caution.

Nature of Toadstool Poisons

Atkinson's account or that of Chesnut recommended in the list of books should be consulted for definite information.

Nutritive Value of Toadstools

In general, it may be said that even the most nutritious toadstools are of little nutritive value, but are valuable as food accessories or condiments, not, in anywise, as substitutes for the meat or vegetable ordinarily consumed.

Cultivation of Toadstools

The details are to be learned from special books and pamphlets. The accounts in the books by Atkinson, Duggar and Hard in the list given below are all excellent.

Books

In general, those interested should consult the various books and pamphlets on the subject, which will lead to the knowledge of other sources of information.

Some to be found (or which ought to be found) in many public libraries are the following:

- *Atkinson, George F. Mushrooms Edible, Poisonous, etc. (Ithaca, N. Y. Andrus & Church, 1901.)
- Chesnut, V. K. Thirty Poisonous Plants of the United States. (U. S. Dept. of Agriculture, Farmers' Bulletin, No. 86. Washington, 1898.)
- Clements, Frederic E. Minnesota Mushrooms (being IV of "Minnesota Plant Studies," published by the University of Minnesota, Minneapolis, Minn., 1910).
- Duggar, B. M. The Principles of Mushroom Growing and Mushroom Spawn Making. (U. S. Dept. Agriculture, Bureau of Plant Industry, Bulletin No. 85, Washington, 1905.)
- *Farlow, W. G. Some Edible and Poisonous Fungi. (U. S. Dept. Agriculture, Division of Vegetable Physiology and Pathology, Bulletin No. 15, Washington, 1898.)
- Gibson, W. Hamilton. Our Edible Toadstools and Mushrooms and How to Distinguish Them. (New York, Harper & Brothers, 1895.)
- *Hard, M. E. The Mushroom Edible and Otherwise, Its Habitat and Its Time of Growth. (Columbus, Ohio, The Ohio Library Co., 1908.)
- McIlvaine, Charles. One Thousand American Fungi. (Indianapolis, Ind., The Bowen-Merrill Company, 1900.)

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THE CULTIVATION OF MUSHROOMS

The Cultivated Mushroom

In the United States the term "mushroom" refers commercially to but a single species *(Agaricus campestris)* of the fleshy fungi, a plant common throughout most of the temperate regions of the world, and one everywhere recognized as edible. From the time of Pliny, and perhaps much earlier, this plant has been sought as an article of diet, and it has been cultivated for many centuries. In the vicinity of Paris it has certainly been cultivated in some quantity since the sixteenth century; and, in paintings of market scenes by old masters of the seventeenth century, a basket of mushrooms frequently finds a place in the composition, thus showing that at that time the sale of mushrooms was generally recognized in a commercial way.

It is unfortunate that this commercial use of the term "mushroom" restricts it to a single species. The erroneous statement is frequently made, therefore, that there is one mushroom, and that all other fleshy fungi are toadstools. In other cases any edible fungus is termed a mushroom, and all of the species not usually eaten are toadstools. It is better to consider all fleshy fungi as mushrooms and to apply special names to species with known qualities. It will be proper, therefore, to speak of *Agaricus campestris* as the cultivated mushroom, although it is very probable that in this country, as well as in foreign countries, several other species of mushrooms will in time be highly prized for cultivation.

The fully expanded plant, or mature mushroom (sporophore) of *Agaricus campestris* is well known to everyone. It consists of a centrally placed stalk or stipe of from two to six inches in height, usually not more than one inch in diameter, and on the end of this stipe there is borne an umbrella-shaped or cap-shaped portion known as the cap or pileus. The diameter and thickness of this pileus vary greatly in different races or varieties of the cultivated form, and also with the conditions of the environment under which it is produced. The general color of the plant varies in the different varieties from an almost pure white, or cream, to the forms which are deep brown, at least with reference to the upper surface of the cap. The stem is usually cream or white and bears on its upper extremity near the cap a ring known as the annulus, which annulus forms a covering and a protecting layer for the delicate under surface of the cap, to the edges of which it was attached previous to the rapid expansion and maturity of the latter. The under surface

* These are especially recommended for first reading.

of the cap is provided with leaf-like or gill-like projections, reaching for the most part from the stem to the periphery of the cap. These are termed gills, or "lamellae." They are constantly pink in color in the white or cream-colored species up to the time of (and sometimes even a day after) the separation of the ring from the cap. Subsequently these gills turn brown and even a deep brownish black. In the brown variety the gills are at first grayish brown, but they also become almost black with age.

As a matter of fact, there are several distinct varieties (or what we may for the present term varieties) of the cultivated mushroom. In the work thus far done by the writer three varieties have been studied, and based upon color they may be distinguished as a white, a brown and an intermediate or cream-gray variety. To these have been applied the trade names Alaska, Bohemia and Columbia, respectively. Under these names the spawns have been distributed to commercial growers.

Spores and Spawn

If one should take a full-grown mushroom after the under surface of the cap has become exposed by the breaking away of the annulus, twist the stem until it breaks away from its attachment to the cap, or cut it off short, and then place the cap, gill surface downward, on a sheet of white paper, there will be found in the course of 24 hours, more or less, a print. In order to avoid drafts of air a vessel may be inverted over the preparation. The print obtained is a fairly good reproduction of the projected form of the gills, being composed of a mass of brownish-black powder which has fallen from the gills themselves. The color of this powder corresponds to the color of the gills, and the development of this material is a very important phase in the growth of the mushroom. It is, in fact, for the production of this powdery mass that the mushroom, as we know it, is formed. The brown powder consists of innumerable minute simple cells in the form of ovate bodies, termed "spores." These serve for the reproduction of the mushroom. They are equivalent to the green powdery mass produced by molds which grow upon cheese, bread and the like. Their function is that of reproducing the mushroom, but they should not be termed seeds. Their structure is so simple and they are in their development so distinct from seeds that a different botanical term should come into general popular use to express this form of reproductive body. Spore is the proper designation for the reproductive bodies of all mushrooms, toadstools and the like.

As a rule, growers do not use these spores directly in growing the cultivated mushroom. Under favorable conditions, however, each minute spore is capable of germination and of producing a thread-like growth, which by subsequent branching and with extensive ramifications may produce in the course of weeks a spider-web-like, or thread-like growth, penetrating the soil, compost or other substratum upon which the spore happens to have germinated. When this thread-like growth which develops from the spore is of sufficient extent to be readily observed, it is known as "spawn." The spawn is known to the botanist as the "mycelium" of the mushroom, and it represents what may be termed the vegetative stage of the fungus. It may grow to a considerable extent, and during this growth it stores up nutriment. Under favorable conditions there are then formed on threads growing near the surface small pin-head or cushion-like areas of growth. These pin-heads represent the earliest visible stages of what we know as mushrooms. With further growth and modifications they become the buttons which we find growing superficially upon the mushroom bed or bursting through the soil. From the pin-head stage to the fully expanded mushroom there may be represented a period of growth ordinarily requiring at least a week.

It is evident that this lowly organized mushroom plant differs very much from our common cultivated green plants. There are no such organs as root, stem and leaf, and a well-differentiated body is only formed when the mycelial threads

have stored up nourishment and are ready to develop the mushroom, or sporophore, which is to bear the reproductive bodies, or spores.

Up to the period covered by the present investigations the spores have seldom been used in a commercial way. The spawn maker has depended upon finding spawn in his pastures, or in his manure piles, or having it appear spontaneously, as it is termed, in prepared beds; and this spawn he has used in the propagation of other spawn by a process which we may liken, perhaps, to that of propagation by cuttings.

Commercial Mushroom Growing

The successful cultivation of mushrooms in America has not been so general as in most of the European countries. It is in France and in England that the mushroom industry has been best developed. France is, properly speaking, the home of the present mushroom industry. Unusual interest has been shown in the United States in the growth of mushrooms within the past few years, and it is to be hoped and expected that within the next ten years the industry will develop to the fullest limit of the market demands. The latter will, of course, be stimulated and developed by the increasing popular appreciation of this product. In some cities and towns there is already a good market demand for mushrooms, while in others they may be sold only directly to special customers. This should be borne in mind by prospective growers.

A glance at the figures indicating the quantity of mushrooms passing through the Central market of Paris will afford a fair idea of the extent of this industry in France. The following tables give approximately the total quantity sold during several successive years and the production by months:

Quantity of Mushrooms Passing Through the Central Market of Paris, 1898-1901

YEAR	Total production	Immediate consumption	Amount preserved	Mean price per pound
	Pounds	Pounds	Pounds	Cents
1898	3,960,000	2,200,000	1,760,000	26
1899	6,820,000	4,092,000	2,728,000	26
1900	8,580,000	4,180,000	4,400,000	25
1901	9,680,000	3,740,000	6,160,000	24

Production of Mushrooms for the Paris Market in 1901, by Months

MONTH	Total production	MONTH	Total production
	Pounds		Pounds
January	902,000	July	734,800
February	895,400	August	651,200
March	941,600	September	653,400
April	917,400	October	649,000
May	985,600	November	655,600
June	877,800	December	726,000

Causes of Failure

Success in mushroom growing depends on intelligent study of conditions and on experience. While many American growers have been successful in the production of mushrooms, a much larger number have failed. In most cases their failures have been due to one or more of the following causes:

1. The use of poor spawn, or of spawn which has been killed by improper storage.

2. Spawning at a temperature injuriously high.

3. The use of too much water either at the time of spawning or later.

4. Unfavorable temperature during the growing period.

It is therefore important to the prospective grower that careful attention be given to the general discussion of conditions which follows:

Temperature and Moisture

Mushrooms may be grown in any place where the conditions of temperature and moisture are favorable. A shed, cellar, cave or vacant space in a greenhouse may be utilized to advantage for this purpose. The most essential factor, perhaps, is that of temperature. The proper temperature ranges from 53 degrees to 60 degrees F., with the best from 55 degrees to 58 degrees F. It is unsafe to attempt to grow mushrooms on a commercial basis, according to our present knowledge of the subject, at a temperature much less than 50 degrees or greater than 63 degrees F. Any severe changes of temperature retard growth, or else act injuriously, and many changes of temperature would entirely destroy the profits of the mushroom crop. From this it is evident that in many places mushrooms may not be grown as a summer crop. With artificial heat they may be grown almost anywhere throughout the winter. Moreover, it is very probable that in this country open-air culture must be limited to a few sections, and restricted, commercially at least, to a single season.

A second important factor is that of moisture. The place should not be very damp, or constantly dripping with water. Under such conditions successful commercial work is not possible. A place where it is possible to maintain a fairly moist condition of the atmosphere, and having such capability for ventilation as will cause at least a gradual evaporation, is, by general practice and by the most extensive experimentation, shown to be necessary. With too rapid ventilation and the consequent necessity of repeated applications of water to the mushroom bed no mushroom crop will attain the highest perfection.

Caves, Cellars, and Houses

Cellars, caves and abandoned mines, or specially constructed houses, are used for growing mushrooms, because in such places only can the conditions of temperature and moisture be best regulated. Cold is less injurious to mushroom beds than heat. The former renders the bed for a time unproductive; but the latter stimulates the spawn to too rapid growth, which is usually followed by the production of unsalable mushrooms, or by the eventual death of the spawn, supposedly by damping off.

Mushrooms may often be grown in a very simply constructed shed or unused barn which will provide against any sudden changes of the temperature, and when it is possible to employ artificial heat the season for mushroom production in such structures may be greatly extended. Cellars are very commonly used in producing mushrooms for family use. Natural or artificial caves are of the first importance, however, for commercial work, since the situation of these below the surface will best insure a temperature throughout almost the entire year more or less close to that which is desired. In selecting caves or cellars, one should guard against the possibility of flooding or of too much seepage water during a rainy season. Perhaps the least satisfactory situation among those mentioned is the greenhouse. Under ordinary circumstances it heats up too readily during days of warm sunshine, and, unless special precautions are taken it is not to be generally recommended for amateurs. Nevertheless, during the fall and winter it is possible to grow mushrooms under the benches or in any other unused space with but very little outlay of money or labor. Cold frames may also be used to good advantage during the autumn or spring. The natural caves of this country and abandoned coal mines in some sections should be further investigated with relation to their adaptability for the commercial production of mushrooms. A

thorough study should also be made of open-air conditions.

In the construction of special mushroom houses any one of a variety of plans may be followed, and the selection of the style will depend, of course, upon its cheapness and efficiency in the particular locality.

Preparation of the Manure

It should be borne in mind that while there are many methods leading to failure there are a number leading to success. In fact, persons succeed in mushroom growing by methods which seem absolutely different. It is essential that the physiological conditions of growth be understood, and then good judgment must be depended upon.

In the growing of mushrooms for commercial purposes, the beds should be constructed of stable manure which has been fermented or composted. Many experiments have been made looking toward the substitution of other composts or waste products for stable manure, but nothing has yet been found which may be more highly recommended. Fresh manure should be obtained, and this should include the litter used for bedding the animals, unless the latter consists of coarse weeds. It is a great mistake, in a commercial way, to attempt to use manure free from straw. Again, stable manure which has been well trampled is nearly always well preserved, and is frequently much richer than any other kind

The manure should be piled in heaps about three feet deep when well pressed down with the fork, and these piles may be of considerable extent. It should be watered until well moistened throughout, but not drenched. In the course of four or five days or a week it will be necessary to fork over or "turn" the manure. A second turning will be required usually in from seven to ten days, and it may be necessary to water again if the material has suffered considerable drying out. If well pressed down and merely moist, the manure will not burn and, moreover, there will be no tendency for a sour fermentation to become established. In from 15 to 21 days, depending upon the conditions, the temperature will begin to fall, the violence of decomposition will begin to show a subsidence and the compost will be ready for the construction of the beds. The bacteria of rapid decay will become less and less abundant, and finally, when the beds are prepared as subsequently described, the spawn will be able to grow in spite of the bacteria present.

It is the custom of some growers to mix a small quantity of loam, about one-fourth, with the manure. This enables one to use the manure earlier; and, indeed, under such circumstances it may sometimes be used with but little or no composting. Nevertheless, the majority of growers have obtained greater success by the use of the manure alone, and this is also the writer's experience. Very well rotted compost should not be used in mushroom growing if large and solid mushrooms are desired. When sawdust or shavings are employed for bedding the animals, the composting may require a somewhat longer period.

The manure is always ready for the construction of beds when the above conditions have been fulfilled, or when nearly all objectionable odors are lost and a sweet fermentation, as growers term it, has begun.

Preparing the Beds

Mushroom beds are of two general types—the flat bed, frequently referred to as the English, and the ridge bed, known as the French type. In making the former the entire floor space may be utilized as a bed, and the beds may be arranged in the form of tiers or shelves. In low cellars or caves, and, indeed, wherever the amount of floor space is not the most important consideration, it would be well to avoid the use of shelves; but where the amount of floor space is an important factor they may be adopted to advantage, although the additional labor involved in the growing of a crop under such conditions is an item to be considered. When shelves are used one should be careful to whitewash these after each crop in order to avoid the increased danger from insect depredations. In any case, flat beds

should be made from eight to ten inches deep.

Ridge beds enable one to get a somewhat greater surface space in a given area, but they are also more expensive so far as the labor of construction is concerned. Nevertheless, under many circumstances they are obviously desirable. They should be about two feet wide at the base, tapering gradually to the apex, and not more than about 18 to 20 inches high when compressed and cased. The custom is to make two such beds in contact, and then to leave a walk way of eight or ten inches between the next two, and so on till the space is occupied. Next to the walls slanting beds may be prepared.

In any case, the manure is made up in the form of the bed desired, and should be firmed or compressed to some extent immediately in order to prevent drying out and burning when the secondary fermentation takes place. At this time the manure should be neither wet nor dry, but merely moist. The only practical test of the proper moisture content of the manure which can be relied upon is when upon compression water can not readily be squeezed out of it.

Spawning

After the beds are prepared the temperature should be, and it usually will be, two high for spawning. After a sudden rise the temperature should gradually fall during the course of a week or more to about 70 degrees or 75 degrees F. At this temperature spawning may take place, but under absolutely no circumstances should a bed be spawned at a temperature greater than 80 degrees F. If brick spawn is used, the bricks are broken into pieces about two inches square, or into from 10 to 12 pieces per brick. These pieces are inserted from one to two inches below the surface, about ten inches to one foot apart, and the bed is then compressed into final shape. Under the most favorable circumstances it is unnecessary and undesirable to water the beds for several weeks after spawning, or until they are loamed and cased. If they dry out rapidly and some water is necessary, it should be given as a surface spraying, for water in quantity applied to the young spawn will almost invariably cause the latter to damp off.

Casing the Beds

An examination of the bed about two weeks after spawning is desirable, and if it is found that the spawn is "running" the beds may be cased with loam. Casing consists in applying a layer of loam from one to one and one-half inches deep to the surface of the bed. This loam should have been secured some time in advance and carefully worked over or screened to get rid of the largest pebbles, lumps and trash. When applied it should be barely moist. Subsequently, if watered at all, it should be merely sprinkled in order to prevent any drying out of the bed. Neither a heavy clay nor a sandy loam should be used for casing purposes, but almost any other soil is good.

Watering

As previously indicated, the spreading spawn should receive no water, or, at least, as little as possible. When, however, the mushrooms begin to appear, more water will be required, and a light sprinkling may be given once or twice each week or as often as the conditions demand. Beds which come into bearing in proper condition should never be drenched. It has been found by experience that under the most favorable conditions a bed will require occasional sprinkling, since, owing to continual evaporation, there will be a gradual loss of water, at least after the mushrooms begin to appear. Sprinklings should be made after the mushrooms have been gathered, and the loam disturbed by the removal of mushrooms should always receive a light sprinkling.

Picking and Preparing for Market

When a bed is in full bearing, the mushrooms should be gathered at least once in two days, and it is well to pick them every day, particularly if the temperature is up to 60 degrees F. or more. Picking is itself an art, and the intelligent grower will soon find that the yield of a bed may be greatly lessened by lack

of judgment in picking. To satisfy the general demands of our markets at the present time it is not recommended to take the buttons; yet if there is a fancy trade for these it should be met. Little or no gain in weight occurs in the mushroom, however, after the veil begins to break, so that mushrooms should not be left after this time. Flat tops are a third-grade article, but these, as well as all defective mushrooms, should be sedulously removed from the bed every day.

In picking, grasp the mushroom by the cap (a large one by both cap and stem), twisting it to remove it easily from the soil. Where the mushrooms come up in large united clusters, it will be best to cut them, in order not to disturb the mycelial connections of all. Some good growers practice "cutting" throughout, but the stubs must decay and are a source of danger. After all good mushrooms from a cluster have been taken, remove any fleshy spawn masses adhering and add fresh loam.

As they are picked, the mushrooms are put into shallow baskets and taken to a sorting and packing table. The stems are cut off and any adhering loam is brushed from the cap. It is true that mushrooms keep somewhat better if the stub is left attached and the loam removed by rubbing, but except in special cases this procedure is not to be recommended. It is not necessary to cut the stem off short, but the market demands that there shall be few long shanks.

For the best trade it is desirable to "sort" the mushrooms, placing only those of nearly the same size in the same packages. It is certainly not well to pack together "broilers" and buttons, if this can be avoided. Defective mushrooms should invariably be thrown out. Mushrooms should be treated as a first-grade product in every way, and therefore the package must be attractive. If the time involved in shipment is not to be very long, they may be put into five-pound splintwood baskets or they may be packed in two-pound boxes arranged in crates as prepared for fruit. Shipments may also be made in boxes of sizes demanded by the general or private trade. Baskets afford excellent ventilation, yet boxes are often to be preferred. If the latter are lined with a blue paraffin or oiled paper, a good color contrast will result and the package will be made much more attractive.

Market Prices

The prices paid for mushrooms in American markets are unusually variable. Perhaps it is fair to say that one should consider from 35 to 50 cents per pound a good average price. In many cities or towns 30 cents would be as much as could be obtained. On the other hand, a price of 75 cents is frequently paid. The unusual quotation of $1 or more is not to be expected. It is true that for a fine grade of mushrooms such prices are paid to retailers by the fancy trade and during special seasons or for special occasions. The grower may well look for the time, however, when the market demands will support a generous supply at a constant but fair price.

The Period of Production

Under favorable circumstances, a bed may come into bearing within six weeks. It usually requires, however, a longer period, and eight weeks may more nearly represent the average conditions. If the conditions have been variable, and especially if at times a very low temperature has prevailed, bearing may be still further delayed. Again, the period of production or the profitable "life" of a successful bed may vary greatly, ranging from five weeks to as many months. As a rule, a bed which produces fine heavy mushrooms will bear longer than one which produces plants of a lighter weight. Many growers think that there is profit in a bed which yields one-half pound per square foot of surface area. One should not be satisfied with less than this, and if the best conditions prevail this yield is far below what should be obtained. Two pounds per square foot is an excellent yield and some of our growers report this amount. Some of the spawn prepared by the Department of Agriculture has also given a yield equal to this maximum. When the conditions for mushroom growing may be so faithfully

reproduced that a yield of two pounds may be made constant, mushrooms may be within the reach of many more persons.

Old Beds

When a bed has ceased to bear, or is no longer commercially profitable, it should be taken down and every particle of the bedding and casing materials removed from the cave, cellar, or house. The manure is still valuable for field and garden purposes, but it is wholly useless and even dangerous for mushrooms because it is not only exhausted with reference to mushroom growing but may also harbor the diseases or enemies of the mushroom. When the bed is removed the house should be thoroughly cleaned, and if possible, sprayed or fumigated. If conditions remain constant there is then no reason why another crop should not follow immediately.

Mushroom Spawn and Its Preparation

As a good spawn is one of the prime requisites to success in mushroom culture I suggest that in buying spawn you deal with firms known to be reliable. During the past few years a number of fraudulent concerns have been advertising extensively and disseminating a great deal of misleading information for the purpose of selling worthless spawn at exorbitant prices. Have nothing to do with those who advertise for sale, books containing "secrets" regarding mushroom culture, who ask $1 to $2 per pound for spawn, or who claim that immense profits can be derived from mushrooms. There are no secrets about mushroom growing. Good English brick spawn can be bought in small lots for about 12 to 30 cents per pound, French flake spawn for 15 to 38 cents per pound, and pure-culture spawn for 15 to 25 cents per cake. Mushrooms are about as profitable and fully as risky as the average greenhouse crop, and, like other crops, require considerable care and work to insure success. Most of the well-known seed firms handle not only the imported, but now also the pure culture spawn, methods for making which were worked out by this Bureau several years ago and are given below.

Brick and Flake Spawn

The process of making mushroom spawn, or of spawn manufacture, as it is commonly termed, has unfortunately received very little attention in this country until recently. Nearly all of the mushroom spawn sold in the American market has been imported. Most of this is grown in England and is put up in the form of bricks or cakes, each brick being about $5\frac{1}{2}$ by $8\frac{1}{4}$ by $1\frac{1}{4}$ inches and weighing from $1\frac{1}{8}$ to $1\frac{1}{4}$ pounds. This brick spawn is frequently spoken of merely as English spawn for the reason that the English article is all put up in this form. The making of brick spawn is not usually practiced by the French growers, who use instead a flake spawn. The explanation of this fact may be that a large number of French growers make their own spawn and the brick method is of course more laborious. The flake spawn consists merely of the loose composted material, equivalent to the ordinary bedding material, through which the mycelium of the fungus has grown abundantly. The brick spawn is very compact and easily handled; and, from the experiments which have been made by this department with the introduction of spawns of various kinds, it would seem to be established that the brick spawn is better fitted to resist the conditions of shipment and subsequent storage. We have, therefore, the curious fact that, although mushroom growing is perfected to the highest degree in France, very little of our imported mushroom spawn comes from that country.

Again, the brick spawn sells at a lower figure than the flake spawn grown by the French. Good flake spawn is, however, such a dense mass of mycelium that as a rule less is required in spawning. The comparative quotations of reliable firms who are agents for this article are as follows:

		Cents per Pound
English brick spawn....	1 pound	—12 to 30
Do	100 pounds	— 6 to 15
French flake spawn....	1 pound	—15 to 38
Do	100 pounds	—10 to 15

The freight rates and import duties

add considerably to the price of these articles, which, in quantity, may be purchased much cheaper where made. It is a useless expense to import a material having such bulk as mushroom spawn. There is nothing in the climate to render the manufacture difficult in America, and good brick spawn is now being made.

When it is recognized that spawn making may go hand in hand with mushroom growing, some growers in this country will doubtless wish to grow the spawn needed in their own work. In such cases the cheaper method of making flake spawn may make it preferable.

Virgin Spawn

Whether the spawn is made as bricks or as flake material, the point of greatest importance is to secure a so-called virgin spawn, or a new growth of the mycelium of *Agaricus campestris*, which has never exhausted itself to any degree by the production of mushrooms. The problem of securing such virgin spawn is a difficult one, and as usually met in England and France it leaves to chance the quality and other characters of the mushrooms which may grow from such spawn. If, accidentally, mushrooms are found growing on the lawns or in pastures, or if mycelium is located in such situations, small trenches are dug beneath the sod and these are filled with rich manure, with the hope that the vigorous-growing mycelium will penetrate this manure in the course of a few weeks. This usually occurs, and the spawn is said to be very good when one prevents the production of mushrooms by this spawn, and, if possible, by any of the mycelium in the vicinity. When the manure in the trenches is well penetrated by the mycelium, the spawn is removed and dried, and it is usually termed virgin spawn. It may then be used in the inoculation of spawn bricks, or it may be used in the inoculation of small beds, either of which, when penetrated by the growing mycelium, may in turn be used as commercial spawn, brick and flake, respectively, which is then sold or used in a commercial way.

In France, where the demands for virgin spawn are very great, there may be found persons who give their whole time to a search for virgin spawn in the various compost heaps which may be found in the suburbs and throughout the country. These persons readily recognize the spawn of *Agaricus campestris*, or, at least, one is led to believe that they are very adept in such recognition, and this virgin spawn, which is supposed to have resulted from the germination of spores in the compost itself, is sold to mushroom growers at a very high figure. The growers use this spawn in small beds, which, when well penetrated with the mycelium, will be broken up and the contents of the bed dried for general crop purposes. Whether the virgin spawn is obtained in this way or in the manner previously described, it is a haphazard method. The spawn from a bed in full bearing, or that from an old bed, should never be used in a commercial way, for a light crop only may then be expected.

Pure-Culture Virgin Spawn
Artificial Production from Spores

It will be evident from what has been said that by such methods the exact characteristics of the mushroom which will be grown will not be known, unless a special experiment is made to determine this before the crop is put in. Selection or improvement of the common varieties will, therefore, hardly be possible under such a system. Several years ago it became evident to the writer that for the development of the mushroom work there was great need of eliminating the "chance" method of securing a good grade of virgin mushroom spawn. It seemed that this might be accomplished through a knowledge of the conditions under which the spores of *Agaricus campestris* germinated. The Department of Agriculture has given much attention to the investigation of this problem during the past three or four years. The results of the first experiments along this line, conducted by Miss Ferguson, were published in Bulletin No. 16 of the Bureau of Plant In-

dustry. At present it is possible to report greater success and a more practical application of that work. It is now possible by means of chemical stimulation to germinate the spores in quantity under "pure-culture" conditions. Unfortunately, at the present time it can not be said that spore-culture methods are unfailingly successful where the pure-culture precautions are not observed. It is confidently expected, however, that within the course of another year it will be within the reach of any practical and experienced grower to develop spawn from spores of selected mushrooms which he may have grown. By these methods one will be able to select the particular mushrooms from which spores are to be taken, and therefore constant selection and improvement will become possible.

"Tissue-Culture" Method

Another line of development discovered through work in the Department of Agriculture yielded even better results than the spore-culture process. It may be termed the "tissue-culture" method, and is described as follows: Test tubes or large-mouthed bottles are filled with fresh stable manure or with compost, and after being plugged with cotton these tubes are sterilized, the sterilization being best effected in a steam-pressure apparatus. They can be sterilized, however, by boiling for one-half to one hour in an open vessel of water, but when this process is used a second sterilization should be given on the following day. This will render these tubes of compost perfectly free from all bacterial or fungous contamination. One should then select from the growing bed vigorous, well-flavored mushrooms of a variety or race which has proved to be unusually prolific. The specimens selected should be large enough to indicate that they have the characters desired. The younger the specimen the better, other conditions not being neglected. With a sterilized scalpel and forceps one may then break off the stem, peel off the outer skin, and remove with great care bits of the tissue of the mushroom without touching any surface which has not been flamed. These bits of tissue may be carefully inserted into the manure in the sterilized tubes. In the course of a week, or sometimes within three days, if no accidental contamination has resulted, these bits of tissue will be found to have sent out a small growth of mycelium. Under favorable conditions this mycelium will spread to all of the material in the tube or bottle in the course of three or four weeks, and it may then be used as pure-culture virgin spawn. These cultures may be made in milk bottles of considerable size; or, once a few tubes have been made, transfers from the mycelium of these may be made to milk bottles containing the sterilized compost, and thus a considerable quantity of an absolutely pure spawn may be produced to serve as inoculation material for bricks or for the flake spawn. It is unfortunate that this method also involves, and must involve, bacteriological precautions. Nevertheless, this process renders it possible to select mushrooms of a given character, or to select toward a given end, with the same certainty with which we may select the seed of other crops commercially grown. Moreover, experiments are now under way which will undoubtedly show that by starting with a few pure cultures this principle may be applied for the production of spawn in quantity.

The Manufacture of Brick Spawn

The bricks should be solid and compact and with no cracks or irregularities in the surface. In order to secure bricks of this kind and the best growth of the mycelium, it has been found by experience that a mixture of manure from the cattle shed and from the stable is desirable. This is usually mixed in the proportion of two-thirds of the former to about one-third of the latter, a small quantity of loam being sometimes added. In making the bricks, the material should be somewhat less composted than for making mushroom beds, and it needs to be well selected or raked over, since too much straw in the brick will render

it brittle and liable to crack. The mixing of the dried materials is an important process and should be carefully done. The bricks are molded in a frame of the size desired, the material being pounded into the frame by means of a mallet. If one follows the most common method, the bricks are only slightly dried, and then spawned. A piece of virgin spawn is inserted at either end, immediately after which they are rapidly dried before being stacked for the growth of the spawn. By another process the bricks are immediately dried without the insertion of the spawn material, which is later placed in depressions made between two adjacent bricks as they are being stacked for the growth of the spawn. In stacking, the bricks are arranged in layers of one or two bricks in thickness, depending upon the method of spawning. Upon each layer there is placed a very thin stratum of fresh manure containing a little clean straw. After the layer of manure is added a very slight watering with a rose spray is given. The whole is then covered with clean straw or litter and left for several weeks, when, under favorable conditions, it should be found upon investigation that the spawn has "run" throughout the bricks.

Occasional examinations of the bricks should be made, however, where experience is lacking, in order to see that they are not too moist and that the growth may not go too far. When properly made, the bricks should be well penetrated by a mold-like growth of mycelium. A considerable cording or threading of the mycelium indicates unfavorable conditions, or that the growth has progressed too far. The latter usually means that the spawn may not prove as vigorous as desirable.

By the methods above outlined, using pure cultures as virgin spawn, a small amount of spawn for experimental purposes has been made by the Department of Agriculture during the past two years. Under favorable conditions this spawn has given unusual yields. Pure cultures were also furnished two growers who wished to co-operate in the experiment. As a result of this co-operation there was put upon the market in 1903 by practical growers an excellent grade of American brick spawn of "pure-culture" origin. There is every reason to believe that this means a great advance.

There can be no question that spawn made by the method above outlined will be a known product; then, if the mushroom from which cultures were made was properly chosen, there may be constant improvement and selection; and furthermore, it is believed that the grower will know what to expect or to demand. Pure-culture methods undoubtedly involve some extra expense; but, if in time it may be possible to dispense with the bacteriological precautions, or to make the spawn by direct inoculation of spores into the bricks, then the same result will be accomplished without pure-culture methods and without the additional expense.

It is to be hoped that spawn makers will also adopt for the spawn the trade names suggested, or at least some trade names for the spawn made from the various strains or varieties or from the cultivated mushroom. When purchasing his spawn, the grower should be able to know whether he is obtaining the white (Alaska), the brown (Bohemia), the intermediate cream gray (Columbia), or other similar strains.

It appears to the writer unfortunate that mushroom spawn, at least in brick form, should sell by the pound. Seedsmen and growers alike are interested in reducing weights when the character of the product is not at all affected. It would be better, having well in mind the cubical content of the brick, to sell the spawn by the brick. Of two bricks differing by half a pound in weight, it may very well be that the lighter is better, owing to the absence of pebbles and of any excess of loam.

Storage of Spawn

It is possible to ruin good spawn by improper storage, even in a relatively short period of time. Spawn should be

kept in a place that will be both cool and dry, but never hot and dry. This should be remembered by both seedsmen and growers, for many failures may undoubtedly be attributed to the improper storage to which the material has been subjected.

MUSHROOM ENEMIES

Under suitable conditions and with the exercise of constant vigilance as to general cleanliness the mushroom bed will seldom fail as a result of diseases or insect depredations. Nevertheless, every precaution should be taken to avoid these difficulties. Some of the most common troubles reported in this country are as follows:

Fogging Off

During the pin-head or button stage, and sometimes even later, the mushrooms, which may be appearing in quantity, turn brown, cease to grow, and soon decay. This is supposed to be a physiological trouble; that is, one caused by lack of essential conditions. Molds and bacteria may play a secondary part at least in producing this disease. It is most frequent in warm weather.

Black Spot

This disease manifests itself by the appearance of small discolored areas on the surface of the cap. It is said to be due to improper watering and to lack of proper ventilation.

Fungous Diseases

There are several fungous diseases of the mushroom, none of which, however, has been of serious importance in this country.

Mites

There are one or two species of mites constantly to be found in compost heaps, which may be injurious in the mushroom bed. They are seldom troublesome at a temperature of less than 59 degrees F., as they are then more or less sluggish; and, although they may be found upon the mushroom, they do little or no harm. At higher temperatures they are supposed to destroy the spawn to a certain extent and, owing to their great numbers, they are at least objectionable upon the mushrooms.

Wood Lice, or "Sow Bugs"

These crustaceans, like the mites, are not of great importance where the conditions of temperature are favorable. The best methods of extermination are by trapping and poisoning them. This may be done by putting pieces of potato smeared with arsenic or Paris green, together with some dry rubbish, into tin cans or boxes placed on the side. Most of the sow bugs that enter these receptacles will be killed by eating the poison.

Snails

Snails and slugs are frequently pests in mushroom growing, but they may also be readily trapped by the use of lettuce or cabbage leaves.

Springtails

Springtails may become a source of great annoyance when mushrooms are grown in damp caves. As a rule, they can only establish themselves when carelessness has been shown in cleaning out old bedding material. When once established they multiply very rapidly, and the mushrooms are attacked by them in such numbers that within a day or two every appearance of fogging off is made manifest. These insects may be readily destroyed by fumigation with carbon bisulphid, but prevention is the wiser course.

Larvae of Flies

With good manure and under suitable conditions larvae of mushroom flies are not usually injurious. Nevertheless, the larvae of the little fly, *Phora minuta*, may be troublesome in warm weather. Fumigation, as previously suggested, may be of service in order that the life of a bed may be extended somewhat later into the warm season.

Muskmelons

The melon is a native of Southern Asia from the foot of the Himalayas to Cape Comorin, where it grows spontaneously, but is cultivated in the warm and temperate regions of the whole civilized world. It is variable both in habit and the diversity of its foliage, but the greatest variation is perhaps in the fruit, which ranges in size from that of a

prune or plum to that of the large squash or an average-sized pumpkin.

The scientific name for muskmelon is *Cucumis melo.*

The scientific name for the watermelon is *Citrullus vulgaris.*

They belong to the same order but different genera.

The fruit of the muskmelon is variable in external appearance as well as in flavor and color of the flesh. It may be round, oval, spindle-shaped, netted or smooth-skinned, ribbed or furrowed, whitish, green, yellow or orange when ripe; scented or scentless, sweet or insipid.

The growing of muskmelons in the United States is an important industry, and the variety called cantaloup* is per-

* See article on Cantaloup Culture.

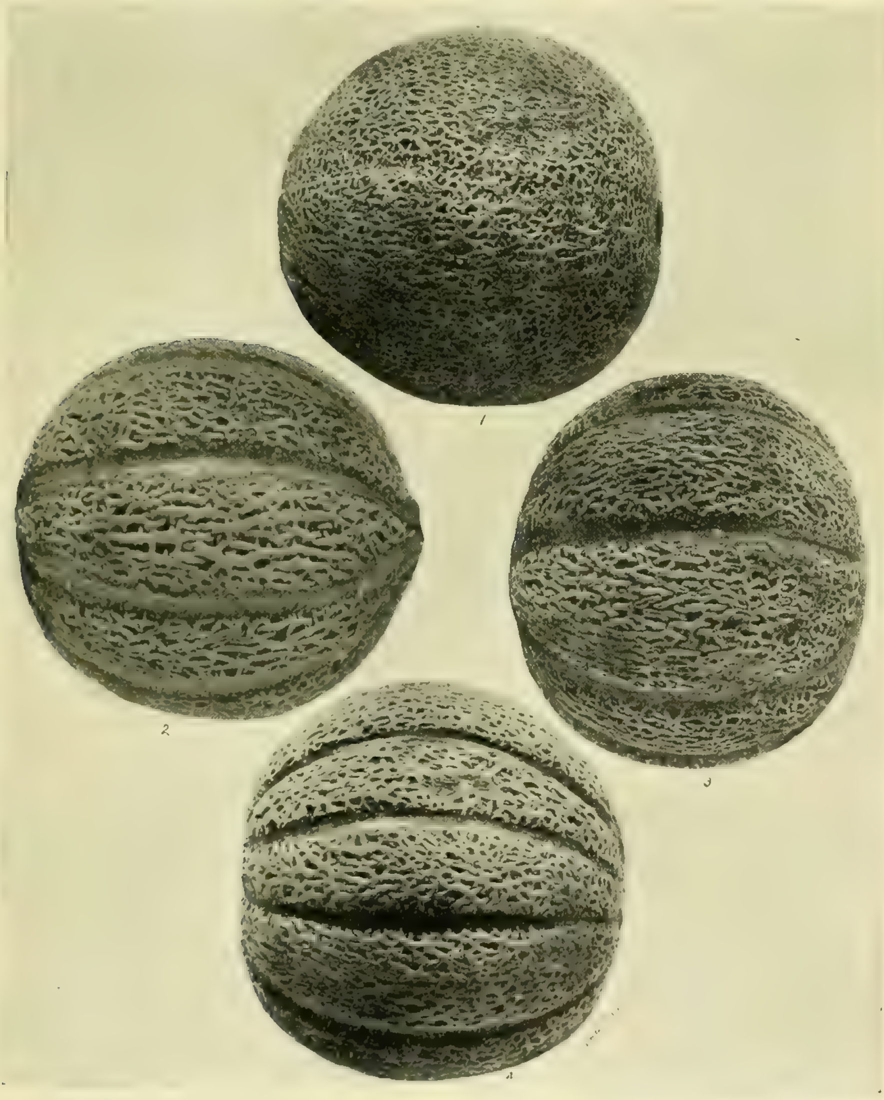

Fig. 1. Variations in Types of Netted Gem Melons. All are good quality but the lack of uniformity is a disadvantage. 1, Ideal Netting. This type of netting is usually associated with high quality.

haps of greater commercial value than the other varieties. In some states there is no distinction made between the names muskmelon and cantaloup, both varieties being called by the same name. In others there is a marked distinction, especially by dealers who use both terms as distinctively as they would use plums and prunes.

If the cantaloup or muskmelon is planted early in the spring, the fruit is generally ready for market by September and may be sold at reasonable profits until late in the autumn. They need about the same treatment as pumpkins, squashes and other trailing vines, but because they are more delicate in flesh and flavor, are generally given more care in picking, crating and marketing.

Muskmelon Culture in the North

Only about one-third as much land is devoted to muskmelon* culture in the United States as to watermelons, but the area devoted to it is rapidly increasing. Owing to its smaller growth it is more easily and successfully grown in northern localities than the watermelon. The states of largest production are widely scattered. New Jersey leads in acreage, followed by Texas, Illinois, Indiana, Maryland, Virginia, Arkansas and Colorado. A number of the experiment stations have published bulletins dealing with the culture of muskmelons. * * *

In a bulletin of the New York Cornell Station J. Craig gives an account of the methods followed by successful farmers in Niagara county, New York, in the culture of muskmelons.

Muskmelon growers in that county secure their early melons by starting the plants either in the hotbed or greenhouse late in April or early in May and transplanting to the open field when all danger from frost is past, usually during the third or fourth week in May. For this early crop the seeds are sown in bottomless boxes, like berry boxes, made for the purpose, and about three inches square and four inches deep. A wad of well-rotted barnyard manure is pressed in the bottom of these boxes, which are then filled with light garden loam well packed down. About five seeds are sown in each box. The seeds are covered by sifting soil over them and the usual attention given to watering and heat. The temperature of the plant house is kept at about 85 degrees F. in the daytime and 60 degrees to 70 degrees at night. Should the "damping off" fungus threaten it is kept in check by free ventilation, careful watering, keeping the heat up during cloudy periods, and by spraying the plants with a solution of potassium sulphid, using about one ounce of the sulphid dissolved in three gallons of water.

As a result of a test of a large number of varieties of muskmelons the New Hampshire Station recommends the following for cultures in that state: Gem type—Oval Netted Gem, Golden Netted Gem, Netted Gem, Rose Gem, Paul Rose and Emerald Gem. Medium type—Extra Early Hackensack, Kinsman Queen, Satisfaction, Chicago Nutmeg, Improved Jenny, New White Japan, Nectar of Angels, Kinsman Queen, Extra Early Cantaloup and Acme. Large long type—Granite State, Long Yellow and Improved Cantaloup. In a more recent bulletin Professor Rane recommends the following varieties for garden culture in New Hampshire: Emerald Gem, Rockyford or Netted Gem, Montreal and Long Yellow.

The New York Cornell Station states that on Long Island and about New York City, Emerald Gem is probably the most popular variety, with Hackensack a close second. In Western New York Netted Gem is the leading variety, followed closely by Paul Rose and Surprise. At the experiment station Osage was one of the best melons tested.

Emerald Gem produces fruits of small size (from 1 to 2 pounds). These have flattened ends, are shallow ribbed and lightly netted, and the flesh is salmon colored. Rockyford or Netted Gem produces melons of about the same size and

* The term "muskmelon" is here used in a wide or generic sense, to include not only the furrowed, hard rind melons known as "cantaloupes," but also the netted, softer rind kinds known as "nutmeg" or "netted" melons. The term "cantaloup" is thus confined to a particular class of muskmelons.

weight as Emerald Gem. They are oval shaped, shallow ribbed, netted and green fleshed. Paul Rose is an early variety belonging to this class, but has salmon-colored flesh. Montreal produces a medium-sized (3 to 6 pounds), oval-shaped, shallow-ribbed, netted and green-fleshed melon. Long Yellow produces a large (over 6 pounds) melon, which is long-shaped (two to three times as long as broad), deep-ribbed, lightly netted, with salmon-colored flesh. It belongs to the true cantaloup class and is a mid-season variety. Hackensack is also a true cantaloup. Its fruits are of medium size (3 to 6 pounds), flattened at the ends, prominently netted and have green-colored flesh. Surprise belongs to the same class as Hackensack, but has salmon-colored flesh. It is a late variety. Osage produces medium-sized (3 to 6 pounds) oblong melons, which are shallow ribbed, very nearly smooth or slightly netted and have a salmon-colored flesh. It is a mid-season variety and fruits over a long period.

Handling the Crop

Even if a standard variety of melon is grown and standard packages employed, unless the melons are handled in such a way as to reach the market in a condition acceptable to the trade, the best results in prices and profits cannot be secured. The methods employed in the picking, grading and packing of the melons have an important influence upon their condition and appearance when they reach the market.

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Organization of the Working Force

Since the entire melon patch must be picked over each day, and since the melons must be shipped the day they are picked, it is essential that a larger force of workmen be maintained than would seem necessary to handle the crop early in the season when the picking is light. It invariably happens that at some time during the season the melons ripen very rapidly, so that a patch which has been yielding 50 to 75 baskets per day may suddenly produce over two hundred; and unless the grower is prepared for such an emergency, some day he will have more melons than he can handle and will lose a large quantity on account of over-ripeness. To be prepared to handle the heavy pickings, the working force must be thoroughly organized early in the season, and while there is plenty of time, each person trained for his particular duty, so that when the inevitable rush does come the entire force will be able to work at its maximum capacity.

The number of workmen needed would depend upon the size of the plantation and the quantity of melons to be handled. Ten persons can easily pick and pack 200 baskets of melons in a half day and do the work in a proper manner, provided the force has been well organized and trained, a suitable packing shed constructed and other facilities provided. The distribution of these workmen would be about as follows: Five pickers who stay in the patch and merely carry their filled baskets to the end of the row or to a driveway through the patch if the plantation is wide; one man to carry or haul the filled baskets to the shed and keep the pickers supplied with empty baskets; one sorter or grader who holds the most responsible position on the force and must be an expert judge of melons; two packers, and one boy to put on covers and stencil the packages ready for shipment.

With such a force in operation the melons are removed to the shade of the shed immediately after picking and are handled directly from the picking baskets to the packing table as they are sorted so that they suffer no injury from repeated handling. A supply of empty baskets for the packers is kept under the packing table where they are within easy reach. The packer sets his filled baskets on the ground behind him where the "lidder" puts on the covers and stencils and then stacks the baskets at the back of the shed.

Picking

There is considerable difference of opinion as to the exact stage of ma-

turity at which melons should be picked for shipment. If allowed to become too ripe before picking they become soft by the time they reach the market and often must be sacrificed in order to effect an immediate sale. If picked too green the melons reach market in firm condition, but are lacking in flavor, and are not desired by the best trade. It is a nice point to pick melons at such a degree of ripeness that they will reach the market in firm condition, and yet possess the requisite flavor. The farther from market the melons are produced the less mature they must be when picked. Furthermore, the rapidity of softening after picking varies with the temperature to which the melons are subjected. The cooler they can be kept after picking the longer they can be allowed to remain on the vines and the better flavor they will have. It is, therefore, essential that the melons be placed in the shade as soon as possible after picking and be kept shaded until they are loaded into the car. For the same reason riper melons can be shipped under refrigeration than in ventilated cars. It is also true that melons shipped during excessively hot weather, unless under refrigeration, will soften more rapidly than those shipped during cooler weather. The condition of the vines and the rapidity of ripening of the melons in the field will also have a bearing upon the stage of maturity at which they should be picked. Early in the shipping season, when the vines are in full vigor and the melons ripening slowly, the fruits may safely be left upon the vines until more mature than would be safe later in the season when the plants have become somewhat weakened, or, by reason of excessive heat, the melons are ripening very rapidly. Melons should not be picked at the same degree of maturity under different conditions of ripening, methods of transportation and distances from market.

While it is true that no rule can be given for picking melons that will apply under all conditions, and that the grower must exercise judgment in reference to each day's picking, the ideal will be attained when the conditions are such that the melons will reach the market in the best condition if picked as soon as the fruit will part readily from the stem when the latter is pressed with the thumb or finger. There is a tendency among some growers to pick considerably before this point has been reached in order to run no risk of the melons becoming soft in transit. In fact, some growers make a practice of picking the melons before a crack appears about the stem or any change of color takes place, even on the under side of the fruit.

Grading

That proper grading results in the securing of better prices than indiscriminate packing is evidenced by the experience of certain growers who have departed from the usual custom and practice a regular system of grading whereby three distinct grades of marketable melons are made and shipped under three different brands. Such a system of grading and branding makes it possible for the commission man to place the different grades with the different classes of trade instead of being obliged to sell the entire shipment as ungraded stock to undiscriminating purchasers. As a result the best grade often brings double the price of ungraded stock on the same market, while the lowest grade usually sells for practically the same as ungraded stock, so that the excess in price received for the higher grades is practically all clear gain as a result of grading.

The quality of a melon is the primary factor which determines its grade, though size and condition are also to be considered. Extremely high quality and uniformity in size and condition are essential in the making of a fancy grade. The size must also be normal and the packing perfect. The No. 1 grade should be of nearly as high quality as the fancy grade, but may include odd sizes, though the different specimens in a given package should be fairly uniform in size. This grade may include melons too large or too small for the fancy grade. The

No. 2 grade should consist of the balance of the salable melons. These should be of fair quality and far superior to the flavorless culls sometimes shipped by unscrupulous growers.

There is a close relation between the amount and character of netting and the quality of a melon, so that after a little experience it is possible to grade melons with extreme accuracy as to quality on the basis of netting. As a rule the denser and more fully developed the netting the better the quality of the melon. The netting should stand out like whip-cords on melons graded as fancy stock. Well-netted melons in which the netting is not quite so prominent, together with off-sizes of the best-netted melons, may be graded as No. 1. Specimens with still less netting, but in which the netting is fairly well developed, may be graded as No. 2. The extent to which the netting is developed is more important than the absolute amount of netting in determining whether a given specimen shall be graded as a No. 2 or a cull. Melons in which the netting is very poorly developed, as well as those without any netting, should be classed as culls. Cracked and over-ripe specimens must be graded as culls even though of fine quality, for they would be likely to spoil before reaching the consumer.

The above considerations refer to the grading of melons from a plantation in which the vines are in a normal and vigorous condition. As the season advances and the vines become somewhat weakened, more and more severe grading must be practiced, until finally it may become necessary to eliminate the No. 1 and fancy grades and ship only No. 2 stock. This stock will be much better netted than that shipped under the same brand earlier in the season on account of the more severe grading, and should be of fully as good quality. All through the shipping season a few melons should be cut and tasted each day, so that the basis of grading may be changed as the conditions warrant. In this way only can the grower be certain that he is shipping the same quality of melon under the same brand throughout the season.

Packing

While the grading of melons as to quality is of extreme importance, the full benefit of such grading cannot be secured unless methods of packing are employed which will enable the melons to present an attractive appearance upon the market. This means that the melons in a given package must be fairly uniform in size, arranged in an attractive manner and so packed that each specimen will remain in the exact position where it was placed by the packer. The packing must be tight and yet the melons not bruised by being jammed into place.

Considerable difficulty is sometimes experienced by growers in packing melons of different sizes. Much of this difficulty can be avoided by grading the melons according to size as well as quality, and adopting different styles of pack to accommodate the different sizes. If this is done nearly all sizes of Gem melons can readily be packed in climax baskets.

Since the basket is larger at the top than at the bottom two distinct sizes of melon must be used in the packing of each basket, though the difference between these two sizes should be as slight as is consistent with tight packing and the handling of the entire crop. The melons in each layer should be as uniform as possible in size and shape.

FABIAN GARCIA,
Santa Fe, N. M.

MONTREAL MARKET MUSKMELON

This highly remunerative variety is grown almost wholly in a small territory near Montreal, Canada While the returns to growers have been phenomenal, the cost and difficulty of raising them has deterred possible growers in other sections. Gross incomes of from $1,500 to $2,500 per acre are reported, the Boston and New York markets taking the bulk of the melons.

They are started in hotbeds and grown in cold frames until the first melons have reached full growth, when the cold frames

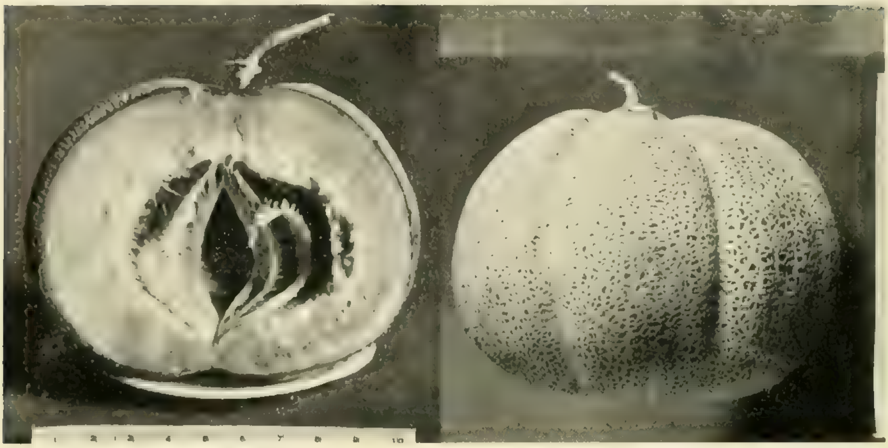


Fig. 1. Montreal Muskmelon.

are removed. They must be handled with extreme care, the vines sprayed often against fungi and red spider and the melons turned frequently and placed upon shingles to keep them from the ground.

Investigation and experiments covering four years led Wm. Stuart of the Bureau of Plant Industry to conclude:

That the Montreal Market muskmelon may be successfully grown in the northeastern states, provided the crop is handled as skillfully and intelligently as it is by the Montreal grower.

That the demand exceeds the supply.

That though a costly crop to grow, sales prices are so high that the enterprise when successful is a highly remunerative one.

References

Vermont Experiment Station Bulletin 169.

Vermont Experiment Station, Report 20, 1908.

DISEASES AND PESTS OF MUSKMELON

The muskmelon is attacked by the same diseases and pests as other cucurbitous crops. See under *Cantaloup Diseases and Pests, Cucumber, Watermelon, Squash, Etc.*

Mustard

The large leaves at the base of the mustard are sometimes used for greens in the spring. (See *Greens.*) Mustard seeds itself and often comes up in the following spring. Some of the Oriental species have an edible turnip-like root. If planted for greens they should be sowed in drills a foot or more apart.

MUSTARD DISEASES AND PESTS

Mustard is attacked by much the same diseases and pests as cabbage, turnips, garden cress and other cruciferae, q. v.

Black Rot

Mustard plants of all species are liable to be attacked by black rot, and if permitted to grow as weeds in fields devoted to cabbage growing will carry the black rot trouble through the rotations in spite of the grower's other efforts. Let no mustard weeds survive in such rotations.

Nebraska

Nebraska is a part of the great central plain and is drained by tributaries to the Missouri and Platte rivers. A part of the state lies in that region known as the Bad Lands, which extends down from South Dakota and is of very little value, except where irrigation is possible from the rivers or from artesian wells.

The soil for the main part is fertile, and corn, wheat, oats and hay are the principal crops. The portion of the state best adapted to horticulture is the southeastern part. This is due to the fact that the surface is broken, furnishing sufficient air drainage. There is in this part of the state, too, the largest amount of

rainfall, reaching an average of about thirty inches per annum, while the rainfall in the Bad Land region is not more than fifteen inches.

The principal fruit is the apple, but the hardier kinds of plums, cherries, peaches and small fruits are grown.

The number of bearing apple trees for the whole state is estimated to be 2,937,178; peaches and nectarines, 1,188.373; pears, 59,285; plums and prunes, 351,321; cherries, 494,468; grapes, 1,221,736 vines; small fruits, 1,411 acres.

The counties producing the largest quantity of apples are: Cass, 143,302; Gage, 132,944; Lancaster, 127.859; Nemaha, 150,516; Otoe, 157,035; Richardson, 175,179; Sanders, 110,124; Valley, 100,603. All of these counties, except Valley, are in the southeastern part of the state. Valley county is near the central part and drained by the Loup river.

GRANVILLE LOWTHER

Frost and Precipitation in Nebraska

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Hay Springs	Sept. 21	May 16	Sept. 6	June 21	19.5
Valentine	Sept. 16	May 9	Sept. 12	June 21	19.3
Lynch	Sept. 24	May 3	Sept. 12	May 26	23.1
Oakdale	Sept. 22	May 1	Sept. 11	May 24	24.1
Tekamah	Sept. 27	Apr. 26	Sept. 13	May 22	32.0
Kimball	Sept. 18	May 15	Sept. 5	June 5	14.9
N. Platte	Sept. 20	May 9	Sept. 10	May 23	18.0
Ansley	Sept. 20	May 8	Sept. 5	May 28	23.0
Genoa	Sept. 24	May 3	Sept. 2	May 27	27.7
David City	Oct. 5	Apr. 17	Sept. 12	May 5	28.8
Omaha	Oct. 12	Apr. 15	Sept. 18	May 19	30.8
Imperial	Sept. 28	May 4	Sept. 7	May 26	19.2
Beaver City	Sept. 29	May 5	Sept. 12	May 26	21.3
Hebron	Sept. 30	Apr. 30	Sept. 12	May 26	28.9
Lincoln	Oct. 8	Apr. 18	Sept. 12	May 7	27.7
Auburn	Sept. 26	Apr. 23	Sept. 13	May 12	35.7

Production of Fruits in Nebraska

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total		1,411	1,171	1,594,421	$159,169
Strawberries	3,425	562	369	654,061	65,772
Blackberries and dewberries	1,982	428	152	501,872	46,648
Raspberries and loganberries	1,128	247	230	265,183	29,841
Currants	1,669	86	161	90,779	8,592
Gooseberries	2,016	88	192	82,086	8,259
Cranberries	...	...	1		...
Other berries	6	(1)	66	440	57

[1] Reported in small fractions.

3 5

Strawberries are the most important of the small fruits raised in Nebraska, with blackberries and dewberries ranking next. The total acreage of small fruits in 1909 was 1,411 and in 1899, 1,171, an increase of 20.5 per cent. The production in 1909 was 1,594,000 quarts, as compared with 1,212,000 quarts in 1899, and the value $159,000, as compared with $98,000.

Orchard fruits, grapes, nuts, and tropical fruits: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes, nuts, and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 3,572,000 bushels, valued at $1,932,000. Apples contributed more than nine-tenths of this quantity, peaches and nectarines and cherries most of the remainder. The production of grapes in 1909 amounted to 4,752,000 pounds, valued at $137,000, and that of nuts 384,000 pounds, valued at $9,000. Most of the nuts were black walnuts.

The production of all orchard fruits together in 1909 was 145.3 per cent greater in quantity than in 1899, and the production of grapes also increased. The total value of orchard fruits increased from $685,000 in 1899 to $1,932,000 in 1909, and that of grapes from $75,000 in 1899 to $137,000 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total		5,061,984		1,750,584	3,572,253	$1,932,124	1,456,053
Apples	57,408	2,937,178	29,920	967,133	3,321,073	1,612,765	1,343,497
Peaches and nectarines	25,199	1,188,373	10,570	263,882	110,180	91,129	8,753
Pears	10,325	59,285	7,821	51,443	6,700	9,802	979
Plums and prunes	18,662	351,321	13,495	184,066	41,910	50,934	42,314
Cherries	41,309	494,468	22,627	267,529	89,876	164,872	54,047
Apricots	3,658	20,451	1,513	8,169	864	1,229	333
Quinces	316	7,761	244	7,165	995	993	(2)
Mulberries	89	3,147	24	1,197	655	400	(2)
Unclassified							[3] 6,130
Grapes	29,403	1,221,736	7,078	380,788	4,752,217	137,295	3,171,034
Nuts, total		[4] 79,090		[4] 37,019	[4] 384,325	[4] 8,906	93,000
Black walnuts	1,553	78,296	574	36,526	381,968	8,740	(2)
Unclassified							[3] 93,000
Tropical Fruits (Japanese persimmons	2	24			6	15	

[1] Expressed in bushels for orchard and tropical fruits and pounds for grapes and nuts.

[2] Included with "unclassified."

[3] Consists of all products not separately named by the enumerator, but grouped under the designation "all others."

[4] Includes almonds, pecans, butternuts, chestnuts, hazelnuts, Japanese walnuts, hickory nuts, beechnuts and other nuts.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	2,736	2.1	Gals	255,886	164,178
Vinegar	1,722	1.3	Gals	109,593	68,134
Wine and grape juice	1,327	1.0	Gals	47,703	38,789
Dried fruits	435	0.3	Lbs	17,793	30,240

Nectarines

The nectarine is a smooth-skinned peach, formerly regarded as a separate species but now known to belong to the peach, *Prunus persica*. It may be produced from the seed of the peach, or by bud variation; or the peach may be produced from the seed of the nectarine, or by bud variation. (See *Darwin's Animals and Plants* under *Domestication*.)

The nectarine is not largely grown for commercial purposes, but in California it is more largely grown than in any other state in the Union. There it is produced mostly for canning or drying, but in all particulars is considered inferior to the peach.

It can be grown anywhere that the peach will flourish.

The varieties grown most commonly in this country are Advance, Boston, Downtown, Early Newington, Elruge, Humboldt, Lord Napier, Orange, Stanwick.

Granville Lowther

NECTARINE DISEASES AND PESTS

The nectarine is attacked by the same diseases and pests as the apricot and peach, which see.

Nevada

The northern portion of Nevada lies in what is often called the Great American Basin between the Sierra Nevada mountains on the west and the Wahsatch mountains on the east. This basin forms a plateau 4,000 feet above the sea. There are numerous parallel ranges from 20 to 50 miles apart running north and south broken by passes and valleys. In the southwestern portion are immense deposits of alkali. Buttes and mountains rise above these alkali plains, making a kind of weird appearance. Wheeler peak is the highest mountain in the state with an elevation of 13,058 feet. The drainage system of Nevada is peculiar in this, that the streams generally empty into lakes that have no outlets, unless it be a subterranean system, or the evaporation which is considerable in that dry and arid climate.

The chief fruit sections are along the eastern slope of the Sierra Nevada mountains. There is much lime, potash and iron in the soil of Nevada, and these, together with the bright sunshine and cold nights, give a fine color to the fruit. Some of the semi-tropical fruits are grown in the extreme south, and fruit growing of this character may become profitable in this state.

Granville Lowther

HORTICULTURE IN NEVADA

P. B. Kennedy

Nevada might be considered as a state whose horticultural conditions on a commercial scale are but little known, yet her possibilities for some kinds of fruit growing are very promising. She is a lavish purchaser of fruits from California. Much of this fruit could and will be grown in Nevada in the future. There are very

few orchards large enough to be considered from a commercial standpoint, but the innumerable small home orchards producing the very best quality of fruit suggest that much larger plantings might be profitably undertaken.

Owing to the great diversity of climate-ranging from a few degrees of frost toward the southern boundary near the Colorado river to 40 degrees below zero in the extreme north or on some of the central desert plains, the state must be divided into several more or less distinct sections. These sections we will designate as:

1. The Sierra section.
2. The Humboldt River section.
3. The Southern or semi-tropical section.

Outside of these will be found scattered ranches 50 or more miles from the railroad, many of which have small orchards from one to four acres which produce most excellent fruit for local consumption.

The Sierra Section

This section includes the land lying along the east side of the Sierra Nevada mountains, including the Truckee valley and those of Pleasant, Washoe, Eagle, and Carson valleys to the south. All of these have excellent railroad transportation facilities. For convenience, although farther inland, we will include the land under the government reclamation project known as the Truckee-Carson Project, with Mason and Smith valleys to the south

The section receives its water supply for irrigation purposes from the Truckee, Carson and Walker rivers, and from numerous smaller local mountain streams. In the Truckee valley nestles the thriving city of Reno. Almost every farm has some land planted out to fruit. In no case, however, does the amount of land devoted to fruit exceed ten acres and in every instance the crop is raised as a subsidiary product of the farm. As would naturally be expected, the orchards located on the foothills above the general level of the valley have more success in escaping numerous and sometimes severe frosts. In the foothill region a full crop may be relied upon without smudging about once in three years, while in the lower parts of the valley a good crop is secured about once in every five years.

Orchard heating has only recently been investigated here, but it bids fair to change the present uncertain condition of an annual crop. The uncertainty of the crop has made it difficult to establish a permanent market. The market has been a local one and little or no grading or wrapping or packing of apples has been carried on. Consequently the growers find it difficult to compete with the selected, packed and wrapped apples from California and the Northwest except at greatly reduced prices. The farmers are usually too busy with the other features of their ranches to give the orchard the necessary pruning, spraying, and cultivation as it is conducted where fruit growing occupies the entire attention of the grower.

Raspberries are grown to a considerable extent and find a ready local market. Usually, however, the patches do not exceed an acre, though it can be relied upon as a sure and profitable crop. Peaches, plums, pears, blackberries and cherries are grown to some extent, but not extensively enough to be considered commercially.

It is of interest to note that there are now no well-established nurseries in the state, the supply coming almost entirely through agents from many different states. The valleys to the south are more favorably located for the growing of fruit because of their close proximity to the timbered Sierra Nevada mountains. In particular we might mention the Washoe valley, where Mr. Ross Lewers, of Franktown, has grown the very best quality of apples successfully for over 50 years without smudging. These old trees still produce good crops. The farm has about 40 acres in fruit. There is not much vacant land in the valley but a great deal that is now used for general farm crops and pasture might profitably be planted to fruit. Farmers who

are hay and stock growers are loath to change to a business that they know and care little about. Mr. Lewers is the only fruit grower in the state that I know of who grades and packs his apples. All the fruit raised is of excellent quality and superb in coloring. The soil is a rich black granite loam abundantly supplied with potash. Forty-two varieties are to be found in the orchard. Of these, Wagener, Jonathan, Newtown Pippin, White and Blue Pearmain, Pewankee, Smith Cider, Winesap and York Imperial are his chief market varieties. The variety Baldwin in this locality is subject to black spot, both in the fruit and limbs.

Pears

There are only a few trees including the following varieties: Bartlett, Gloux Marceau, Seckel, Sugar, Flemish Beauty, Duchess of Anjouleme, and Winter Nelis.

Plums, prunes, cherries and peaches are not grown extensively enough to be considered commercially. Grapes seldom produce fruit, the variety Isabella is the most promising.

There are no extensive plantings of any one variety of apples throughout the entire Sierra section, but the number of varieties represented is unusually large.

The varieties that might be recommended for planting where little or no smudging is carried on are Rome Beauty, Ben Davis, Ralls, Jonathan and York imperial.

A small collection of apples from the Truckee valley were exhibited at the New York State College of Agriculture exhibit in November, 1912. The following received prizes: Beach, Collins, Chicago, Walbridge, White Pearmain, Willow Twig, Hoover, Green Newtown and Smith Cider.

The Humboldt River Section

This includes the valleys lying on the east and west side of a high range of mountains extending for about 100 miles north and south in the eastern part of the state, the Ruby or East Humboldt mountains. The Humboldt river with its tributaries supplies water to ranches extending over a territory of 300 miles or more.

There are numerous small orchards in this section which produce fruit more or less irregularly but definite information regarding them is not at hand. The majority of them are simply planted and after that left to care for themselves. The numerous canyons coming down from these mountains furnish at their mouths excellent soil as well as good atmospheric drainage and water, and when investigated may prove excellent localities for fruit growing. Land is plentiful and can be secured at a very reasonable figure.

In both the Sierra and Humboldt sections the water right is secured at the time of purchasing the land and is pertinent to it.

The Southern and Semi-tropical Section

In this section we include the southern part of the state as represented in Nye, Lincoln and Clark counties. The truly semi-tropical part of the section is located in Clark county, which is the southern half of what was until a few years ago part of Lincoln county. The chief horticultural districts are in the Muddy or Moapa valley, and in the Las Vegas, Pahrump and Pahranagat valleys. The soil of the Moapa valley is capable of producing large crops of alfalfa, grains, vegetables and fruits. A branch railroad through the valley connects with the transcontinental line from Los Angeles to Salt Lake.

The water in the lower valley is controlled by a co-operative corporation. The claimants assigned to the Moapa Irrigation Company all water rights and received shares in proportion to water turned in, also forfeiting all rights of priority. The water is divided into preferred and common stock. A share of preferred stock entitles the holder to three acre-feet of water from May 1st to October 1st, and one-half acre-foot per month for the remaining seven months, October 1st to May 1st. The preferred stock has preference over common stock during the time they both draw water. The assessments are limited by the stockholders and made to cover all expenses,

such as ditch, repairs, water development, etc. Preferred stock is very difficult to secure at the present time and is valued at $100 per share. There is still a large amount of land lying idle, largely on account of the owners having no preferred stock. Much of this land could be utilized by the use of common stock and moisture conservation methods for the remainder of the year.

The climate may be considered as one of hot summers and delightful winters. The dryness of the atmosphere prevents any feeling of depression and permits of farm operations at all times. There is no snow and the annual rainfall ranges from seven to eight inches. Fall frosts are encountered between October 20 and November 20 with fair regularity. Harmful spring frosts are little known, none occuring after the middle of March.

General farming has been the practice until a few years ago because of the lack of transportation facilities. A great change has taken place within a few years and higher priced products, both fruit and vegetables, are being raised extensively and successfully.

The land is well adapted to the raising of asparagus. Tomatoes grow profusely and if a canning factory is established will be a leading industry. To a similar extent lettuce, peas, onions, potatoes, and all kinds of vegetables are raised for the spring markets. Sweet potatoes thrive in red sandy lands.

Among the fruits, apples, pears, peaches, nectarines, almonds, figs, pomegranates, plums and prunes, have proven with many years of experience on small tracts to produce good crops.

The Thompson's seedless grape flourishes and at Bunkerville it is now the leading industry. Table grapes have been grown but the lack of market some years ago discouraged the growers. The cantaloup industry is well established, many carloads being shipped every season. Peanuts grow readily, orange and lemon trees are frequently killed to the ground during the winter. English walnuts seem to require more humidity. Pecans and olives are in the experimental stage.

The Las Vegas valley, in which is situated the thriving railroad town of Las Vegas, is an immense valley. Here water for agricultural purposes can be secured from artesian wells. The climate is similar to that of the Moapa valley but the plantings of fruit are yet limited.

Southern Nevada offers many opportunities to those interested in the growing of fruit and vegetables. Land can be procured now at the ordinary prices for irrigable farm lands. Eventually farms will be selling at the high prices now prevailing in Southern California and the Hood River valley, Oregon.

Conclusion

In conclusion we may state that definite information on Nevada horticulture, as to the number of acres planted to fruit trees and the area in bearing is not known by anyone at the present time. A movement is now being urged by the Agricultural College of the University of Nevada for an appropriation to make a horticultural survey of the state so that the conditions may be better known and the amount of land available that might be offered to homeseekers desirous of engaging in horticultural pursuits.

University of Nevada, Reno, February 12, 1913.

Frost and Precipitation for Nevada

Station	Frost: Average Date of First Killing in Autumn	Frost: Average Date of Last in Spring	Frost: Date of First in Autumn	Frost: Date of Last in Spring	Precipitation: Annual inches
Winnemucca	Sept. 23	May 13	Aug. 22	June 20	8.4
Elko	....	....	....	....	7.7
Carson City	Sept. 20	May 20	Sept. 8	June 18	10.8
Potts	....	....	....	....	7.3
Ely	....	....	....	....	12.4
Hawthorn	....	....	....	....	3.4
Pioche	....	....	....	....	11.2

Production of Fruits in Nevada

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	....	37	53	50,287	$5,683
Strawberries	19	5	14	11,189	1,218
Blackberries and dewberries	11	1	4	1,078	164
Raspberries and loganberries	33	9	7	17,841	1,901
Currants	79	11	16	8,824	1,083
Gooseberries	99	11	8	11,355	1,317
Other berries	....	....	4	....	....

The total production of all small fruits in Nevada in 1900 was 50,287 quarts and in 1899, 76,860 quarts, and the value was $5,683 in 1909, as compared with $8,786 in 1899. The most important of the small fruits in 1909 were raspberries and loganberries.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 86,576 bushels, valued at $82,695. Apples contributed nearly seven-eighths of this quantity. The production of grapes in 1909 amounted to 376,205 pounds, valued at $12,045. The production of nuts and of tropical fruits in this state was unimportant.

The production of all orchard fruits together in 1909 was nearly six times as great as in 1899, while that of grapes also increased. The value of orchard fruits increased from $10,433 in 1899 to $82,695 in 1909, and that of grapes from $5,856 in 1899 to $12,045 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	......	94,222	....	29,002	86,576	$82,695	15,287
Apples	625	74,454	346	16,868	74,449	66,097	10,760
Peaches and nectarines	237	6,329	163	5,049	3,171	4,500	2,563
Pears	380	3,946	201	2,215	4,083	5,119	903
Plums and prunes	420	6,716	176	3,155	3,857	4,654	542
Cherries	199	1,588	118	787	481	894	114
Apricots	128	1,035	73	879	524	1,418	280
Quinces	22	154	19	49	11	13	(2)
Unclassified	......	....	....	....	....	....	[3] 125
Grapes	108	26,607	45	7,941	376,205	12,045	287,600
Nuts, total	....	[4] 972	....	[4] 725	[4] 10,250	[4] 655	2,970
Persian or English walnuts	8	39	11	148	200	20	80
Almonds	40	859	15	495	7,550	606	2,890
Tropical Fruits, total	....	3,412	....	971	....	1,733	....
Pomegranates	57	2,887	21	541	45,550	915	(2)
Figs	63	525	34	430	29,270	818	4,290
Unclassified	....	....	....	....	....	....	10,970

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and tropical fruits.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes pecans, black walnuts, filberts, pistachio and chestnuts.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	19	0.7	Gals	10,610	....
Vinegar	24	0.9	Gals	3,210	....
Wine and grape juice	11	0.4	Gals	2,693	2,074
Dried fruits	32	1.2	Lbs	64,536	6,580

New England

THE APPLE INDUSTRY—HISTORY

The development of the apple industry is one of the most interesting pages in the history of New England. Space will not permit of more than a mere mention of the salient points, or those having a direct bearing upon the present condition of the industry. Commercial apple growing is not a new industry, nor yet is it an old one. During the first half of the last century many commercial orchards of modest size were in existence, but they were composed mostly of seedling trees or "native fruit," the product of which was used largely in the manufacture of cider. The planting of real commercial orchards, however, did not occur till about 1850, when many named varieties of apples were disseminated. About this time many of the old seedling trees were top-grafted and many young orchards started. The methods of management adopted by the commercial orchardist of this time were similar to those practiced in the old cider orchards, but owing to favorable soil and climatic conditions, rather than to superior methods, the trees thrived remarkably well.

The first set-back to the industry came with the large yields of fruit, for which, owing largely to inadequate transportation facilities, there was insufficient demand. Many manufacturing towns at that time were still far from

the railways. Moreover, people had not become accustomed to using apples, for fruit was then considered an unnecessary article of diet.

Following this apparent overproduction of fruit, and with the opening up of large tracts of farm land in the West, came a general decline in land values, causing heavy losses both to landowners and banking houses. The apple growers became discouraged and many of them abandoned their farms and went West to take up land and to follow grain growing.

Of those who remained in the East, many cut down their orchards entirely, and others allowed them to remain with a hope that even without attention, they might produce enough to supply the family with fruit and cider. In this way the apple orchards came to be a side issue, or an adjunct to the regular farm system.

With the development of the fruit interests, the destructive action of injurious insects and of fungous diseases became relatively more pronounced. Apple scab suddenly became a serious pest, the codling moth became more abundant, the canker worm periodically worked destruction, and finally the San Jose scale made its appearance. The fruit growers knew very little about insects or diseases and still less about methods of control. It is not surprising, in the face of such obstacles, that so little progress has been made in the growing of apples on a commercial basis.

Present Conditions

Many of the orchards of the early days are still in existence. In some of them, live stock have been allowed to pasture. In others, successive crops of hay have been harvested and in these the soil has become so depleted in fertility that the trees are dying from starvation. In still others, brush has been allowed to grow up, and it is not an uncommon occurrence to find apple trees at regular orchard distances growing in the younger forests. A few of the early planted orchards are being moderately well cared for and are producing profitable crops. Some may be profitably renovated and others have passed the point of profitable production and should be grubbed out. Many of the old orchards are not well situated, the early planting having followed along the valleys. The few orchards on the higher levels invariably produce fruit of better quality and appearance.

Neglected Orchards

The greatest hindrance to the apple industry in New England today is the presence of so many uncared for apple trees. One of our prominent apple buyers recently made the remark that it would be a good thing for New England if all apple trees within its borders were "wiped out." That is, he believed that in order to get rid of the worthless trees we could afford to sacrifice all the good ones. This is probably true, but we would rather keep the good ones. The advent of the San Jose scale in our New England orchards was to many fruit growers the "last straw," but, in the opinion of the writer, it is on this little insect that we must depend to destroy these worthless trees. It is rapidly accomplishing this task, especially in Connecticut, Massachusetts and Rhode Island.

The apple will stand neglect probably better than any other crop, and a tree without any care will continue to bear fruit for many years. A knowledge of this fact on the part of the New England farmers has been the cause of such wholesale neglect as is in evidence everywhere, and is largely responsible for the present condition of the industry. The farmer has learned that corn and potatoes, if not fertilized and cultivated, will fail, and that cattle and hogs if not fed, will immediately show the effect of neglect, but the apple orchard he has come to know will bring fair returns, even without attention. A farmer in the neighborhood of the college was asked recently which crop on his farm paid him best. He replied that his apple crop undoubtedly was his best-paying crop. Yet this man is spending his energies raising corn and hogs, and allowing a 30-acre apple

orchard to be eaten up with canker worms and to die from starvation.

The Effect of Insects and Diseases

Although the benefits of spraying have been repeatedly demonstrated, and although so much has been written on the subject, there are comparatively few sprayed orchards in New England. Even the orchards that are said to be sprayed are not thoroughly treated. The applications usually are not made at the proper time and are not repeated often enough, and moreover, the spraying machinery in common use is entirely inadequate for thorough work. The codling moth has become so abundant that seldom more than ten per cent of the apples on an unsprayed tree escapes its ravages. The apple maggot is becoming a serious pest. The curculio is very destructive in many localities. The injury from the aphis or louse is more serious every year. The canker worm, from time to time, completely defoliates the trees. The San Jose scale is spreading rapidly and is now well established in most parts of New England. The apple scab, the rust, and sooty blotch diseases are usually present to a greater or less extent. Many other insects and fungous pests of minor importance are usually in evidence every year.

The Disposal of Low-Grade Fruit

The evaporating industry, which has become such an important industry in the apple sections of New York state, has not developed in New England. Relatively small quantities are used by the canning trade and for the manufacture of vinegar and beverages. The remainder of the low-grade fruit, except some of the very poorest, is sent to market and enters into competition with the higher grades and at the same time seriously affects the reputation of local fruit. Any industry that will utilize the fruit which is unsuitable for packing into boxes or barrels should be encouraged.

Careless and Dishonest Packing

The manner in which apples are prepared for market is of utmost importance and the success of the Western growers is largely due to their superior methods of grading and packing. Their progress in this direction has been greatly enhanced by the careless and dishonest packing so prevalent among the Eastern growers. At the present time there is no recognized system of grading among New England growers; neither is there any uniformity in the character of package. The adoption of some form of voluntary inspection and some uniform method of packing, undoubtedly would be of value in our efforts to regain the confidence of the Eastern buyers and to develop a reputation in foreign markets.

Specialization and Co-operation

Co-operation, also, in the hands of the Western growers, has been a powerful factor in the way of securing suitable transportation facilities and rational freight rates. In the East co-operative methods in fruit growing have received very little attention, and their adoption there, under present conditions, would be of doubtful value. When apple growing becomes a specialized industry in any particular locality, the existence of a local co-operative association would be of value in the way of reducing the cost of packages, fertilizers, spraying materials and the like, and possibly may become useful from a marketing standpoint.

The Lack of Capital

Probably the greatest need of New England agriculture at the present time is capital. Banking houses and men of capital have lost confidence in New England soil and are eagerly investing their capital in agricultural enterprises of the West. This lack of confidence may be attributed partially to the great losses sustained by the depreciation of land values a few decades ago. But the most potent reason for the investor's change of attitude was, undoubtedly, the lack of confidence displayed by the farmers themselves. It is therefore the first duty of the present-day fruit grower to prove to the investor that there are still great opportunities for investment in rural New England. The use of demonstration orchards to show the possibilities of

apple growing and to demonstrate to the New England farmer the best methods of management, would have a far-reaching influence. If the Eastern grower proves that he can grow apples of a high grade and can put them on the market in proper condition, it will not take long for the investor to see the superior advantages for investment in New England.

From the foregoing remarks it is plain that in the interests of the apple industry, New England needs to cut down all her old, unprofitable and worthless apple trees; to renovate the best of her existing orchards and to start new ones on the higher elevations; to plant varieties of high quality; to follow the most approved methods of orchard management; to adopt some system of inspection to insure honest and uniform packing; to employ modern and standard packages; to devise some way of disposing of her low-grade apples, without bringing them into competition with the better fruit; to adopt more business-like methods in disposing of the marketable fruit; and to bring the industry to such a state that it will attract keen business men and men of capital, and, most important of all, capital itself.

Outlook for Apple Growing in New England

While apple growing throughout the greater part of New England has for a long time been on the decline, there now seems to be a general awakening. Many young orchards are being started and the industry is attracting some intelligent men and considerable capital. When more people engage in apple growing and when the business becomes the leading industry in any section, the enterprise will become more interesting and profitable.

Favorable Soil and Climate

When we know that in New England apples have been grown for more than two centuries, and when we see the many successful commercial orchards of today, no further argument in favor of soil and climatic conditions is necessary. There is probably no other section of the country that possesses such a variety of soils and offers such a wide range of altitude and exposure. In view of the peculiar adaptations of many of our varieties of apples, this is an important item. The yearly rainfall is sufficient to render irrigation unnecessary, yet we seldom fail to have enough clear weather during the blossoming season to insure adequate fertilization of the blossoms. When proper attention is given to matters of site and exposure there is little danger from late spring frosts. There has been much said and written about the "worn out soils" of New England. With our better knowledge of soils we have learned that any soil that was once productive can be made so again and can be made continuously productive by proper methods of management. Some of the soils of New England are so well suited to apple growing, that for many years they have been producing large crops of handsome fruit without the addition of a pound of fertilizer. Some soils are not only producing large *undeserved* crops of apples, but are supplying a large part, if not all, of the hay used on the farm. Such soils, however, cannot retain their fertility much longer, without the addition of plant food to make up for that removed by repeated cropping.

C. D. Jarvis,
Storrs, Conn.

New Hampshire

New Hampshire is comparatively unimportant from a horticultural standpoint on account of the relatively small area devoted to the culture of fruits. Apples, however, are produced to a considerable extent.

The soils of New Hampshire are comparatively fertile in the valleys, but the highlands are rough, rugged and mountainous. The presence of boulders and the uneven surface, prevent the use of machinery to any very large extent.

The total number of acres in small fruits in 1910 is estimated to be 618, in 1900, 730. Of this amount, 310 acres were in strawberries and 109 acres in cranberries. Of other orchard fruits the total number of trees of bearing age

was 1,368,937; and of this number 1,240,885 were apples; showing that peaches, pears, cherries and other fruits, were practically negligible.

For additional information on ORCHARD SITES AND SOIL, see *Selection of Site* under *Apple Orchard*.

Small fruits: 1909 and 1899. The next table shows data with regard to small fruits on farms.

Strawberries are by far the most important of the small fruits grown in New Hampshire, with the raspberries and loganberries ranking next. The total acreage of small fruits in 1909 was 618, and in 1899, 730, a decrease of 15.3 per cent. The production in 1909 was 998,000 quarts, as compared with 1,230,000 quarts in 1899, and the value $107,000, as compared with $117,000.

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	....	618	730	998,244	$107,365
Strawberries	1,594	310	307	638,057	68,552
Blackberries and dewberries	522	67	65	75,913	7,793
Raspberries and loganberries	657	85	80	86,558	11,821
Currants	838	42	24	43,319	4,587
Gooseberries	139	5	4	5,841	683
Cranberries	238	109	23	30,304	2,686
Other berries	136	(1)	227	118,252	11,243

[1] Acres reported in small fractions.

Orchard fruits, grapes and nuts: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	......	1,368,937	....	271,153	1,165,044	$719,777	2,017,880
Apples	20,420	1,240,885	5,311	207,289	1,108,424	637,990	1,978,797
Peaches and nectarines	2,724	57,571	1,236	35,213	23,218	37,884	6,054
Pears	7,013	36,816	1 690	9,397	24,224	25,206	19,341
Plums and prunes	3,714	23,152	1,647	12,562	7,542	14,039	4,942
Cherries	2,217	9,463	931	6,326	1,403	4,133	1,183
Apricots	61	128	26	85	27	68	2
Quinces	242	909	102	281	205	456	(2)
Mulberries	2	13	....	....	1	1	(2)
Unclassified	.	......	. .	....	....	....	[3] 7,561
Grapes	3,184	15,802	506	3,016	375,164	10,926	487,500
Nuts, total	.	[4] 10,188	....	[4] 3,064	[4] 254,521	[4] 3,684	249,900
Black walnuts	163	1,518	13	208	13,330	375	(2)
Hickory nuts	101	1,268	14	1,329	8,446	303	(2)
Chestnuts	70	1,684	5	461	5,479	242	(2)
Butternuts	532	5,432	47	1,051	217,431	2,597	(2)
Unclassified	.		.	.. .	. . . .	....	[3] 249,900

[1] Expressed in bushels for orchard fruits and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes small amounts of oil nuts.

The total quantity of orchard fruits produced in 1909 was 1,165,000 bushels, valued at $720,000. Apples constituted over 95 per cent of this quantity; peaches and nectarines and pears most of the remainder. The production of grapes and nuts was relatively unimportant. The nuts consisted chiefly of butternuts.

The production of all orchard fruits together in 1909 was 42.3 per cent less in quantity than that in 1899, and there was also a decrease in grapes. The value of orchard fruits increased from $708,000 in 1899 to $720,000 in 1909, while that of grapes declined from $14,462 in 1899 to $10,926 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	5,794	21 4	Gals	671,684	764,410
Vinegar	1,835	6 8	Gals	115,894	98,469
Wine and grape juice	236	0 9	Gals	2,846	2,642
Dried fruits	63	0 2	Lbs	1,768	18,870

New Jersey

Erosions from the rocks of the Alleghany mountain range and glaciers have largely determined the character of the soil in the western and northern parts of New Jersey, while the coastline and adjacent territory are sandy. In the higher elevations back from the coast are considerable mixtures of clay suited to general farming such as the growing of corn, wheat, oats, hay and grass. The extremely sandy soils along the coast are not the most productive, but the sandy loams with a considerable mixture of humus are very fertile and adapted to the growing of potatoes, sweet potatoes, watermelons, cantaloupes, tomatoes, strawberries, etc.

New Jersey, more than any other state except perhaps Florida and California, is devoted to fruit growing and trucking. About 22 per cent of the farming area is devoted to fruits, while 35 per cent is devoted to vegetables.

Several years ago, the principal fruit grown was peaches. In The New Cyclopedia of American Horticulture, A. T. Jordan, on the basis of the census of 1900, wrote as follows:

"The fruit of the state of New Jersey is the peach. The area devoted to its culture exceeds that of all other fruits combined, by about 100 acres. The next fruit in importance is the apple, although the area devoted to its culture is less than one-third that of peaches."

Diseases of different kinds soon after affected the trees, so that the growing of peaches became less profitable than formerly and many orchards were cut down. Later discoveries were made as to how to destroy the enemies of the peach, and the industry again became profitable. However, it has not regained its relative importance. In 1909 the total quantity of orchard fruits was 2,372,000 bushels, valued at $1,975,000. Of this amount apples contributed about three-fifths, and peaches, nectarines and pears, most of the remainder. The apple trees of bearing age, according to the census of 1910, were 1,053,626; peach trees of bearing age, 1,216,467. This shows very little difference between apples and peaches, but the apples not of

bearing age were estimated at 599,749, while the peaches not of bearing age were 1,363,632, or more than twice that of apples. This indicates a new stimulus in the growing of peaches to which the state is unquestionably well adapted.

The counties with more than 100,000 bearing apple trees are Burlington, 104,-009; and Monmouth, 181,232. The counties with more than 100,000 bearing peach trees are Monmouth, 111,536, and Hunterdon, 309,476. There are in the state 8,-648 acres devoted to strawberries. The counties that are the heaviest producers of strawberries are Atlantic, Burlington, Camden, Cumberland, Gloucester and Monmouth.

In the growing of cranberries, New Jersey exceeds any state in the Union with 9,030 acres of bearing shrubs. The only state that approaches this area is Massachusetts with 6,577 acres. Since the whole area in the United States devoted to cranberries is only 18,431 acres, it will be seen that New Jersey has nearly half as much land devoted to this industry as all the other states combined.

Situated as it is on the Atlantic coast and so near to New York, Philadelphia and Baltimore, no other state has better market facilities than New Jersey.

Arthur J. Farley, in *Apple-Growing in New Jersey, says:

New Jersey has never enjoyed a national reputation for the production of apples commercially. The last census (1910) ranks the state as 45th in area, 11th in population and 23rd in the amount of apples produced among the states and territories of the United States. At first thought it would seem that New Jersey was not very well adapted to the production of apples, but when the area of the state is taken into consideration it is clear that apple growing is quite an important industry. The large amount of high quality fruit that is being grown in the state at the present time is good evidence that the conditions are suitable for commercial apple production. There are several successful orchards of 200 acres in the state and a large number of smaller orchards that are showing a liberal margin of profit.

Favorable soil and climatic conditions for apple production exist in a considerable portion of the state, evidence of which is shown by the fruit of high quality that is being produced by growers who practice modern orchard methods.

New Jersey apple growers are particularly fortunate in being located within easy shipping distance of such large markets as Philadelphia, Newark, New York and the seashore resorts. In addition to these large markets there are many smaller towns and cities where the demand for high-class apples far exceeds the supply of locally grown fruit. The reason for this can easily be seen by comparing the population of the state with the amount of fruit produced in the state. Efficient railroad service, combined with modern state and county highways, make transportation rapid and comparatively inexpensive.

The state of New Jersey offers a wide range in altitude, topography and soil conditions. The altitude ranges from sea level, along the eastern and southern boundaries of the state, to 1,800 feet in the extreme northern portion. The average altitude is somewhat below 800 feet, enough to give sufficient air drainage for the production of healthy, vigorous apple trees and high-quality fruit. That portion of the state lying to the southeast of a line drawn between Trenton and New Brunswick is a coastal plain region having a maximum altitude of 200 feet. The northern portion of this plain is quite rolling, while the southern portion is comparatively flat. Along the coast there are large areas of swamp and tide marsh, unadapted to fruit growing. This applies to the eastern portion of Atlantic, Burlington and Ocean counties and to various portions of Cape May county.

There are orchardists in the state who have secured sufficient returns from the sale of vegetable crops, grown between their young apple trees, to pay for the development and care of the orchard until

* New Jersey Experiment Station, Circular No. 30.

the trees came into profitable bearing. This is a very important consideration in the development of an apple orchard, and should not be overlooked in selecting a location.

Varieties

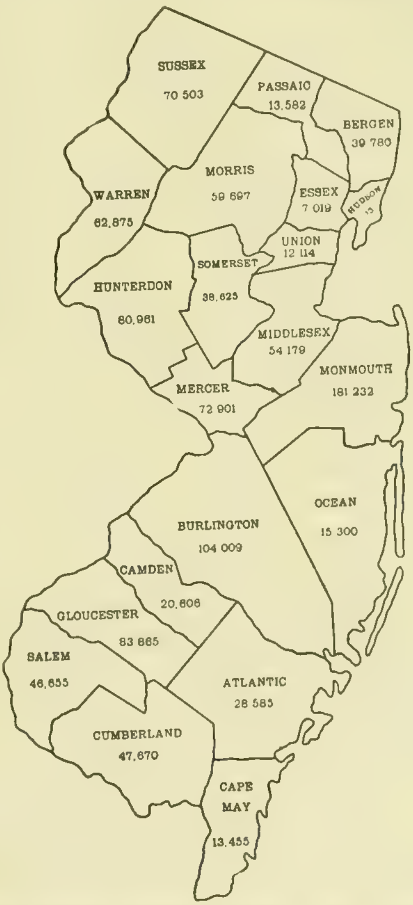
The varieties recommended for New Jersey are as follows: Yellow Transparent, Williams, Duchess of Oldenburg, Gravenstein, English Codlin, Nysack Pippin, Starr, Maiden Blush, Fall Pippin, Delicious, Rome Beauty, Stayman Winesap, Baldwin and Paragon.

Some of the above varieties are only profitable in certain sections of the state. Baldwin, usually a winter apple, becomes a fall variety in the southern portion of the state, and is recommended for planting only in the central and northern counties. Winesap, on the other hand, is recommended for planting in the sandy loam soils, such as is found in Glouster and Burlington counties.

For additional information on orchard sites and soils, see *Selection of a Site*, under *Apple Orchard.*

The conditions in New Jersey make the production of summer and fall varieties of apples quite profitable. There is less competition in the apple market at this time of the year owing to the fact that most of the summer varieties will not stand long shipment. This fact prevents apples being shipped from the West and South into the large Philadelphia and New York markets to compete with the fruit grown in New Jersey and other neighboring states. The increasing demand for high-class fruit at the various seashore resorts makes the summer apple particularly profitable in New Jersey. The summer apple goes direct from the orchard to the market without any expense for storage and re-sorting, thus making the expense of handling much less than in the case of winter apples.

GRANVILLE LOWTHER



Map Showing Number of Apple Trees in New Jersey.

Frost and Precipitation in New Jersey

Station	Frost: Average Date of: First Killing in Autumn	Frost: Average Date of: Last in Spring	Frost: Date of: First in Autumn	Frost: Date of: Last in Spring	Precipitation: Annual inches
Dover	Oct. 4	May 10	Sept. 15	May 29	51.2
New Brunswick	Oct. 16	Apr. 16	Sept. 15	....	48.0
Asbury Park	Oct. 21	Apr. 19	Oct. 3	May 29	48.1
Morristown	Oct. 20	Apr. 23	Oct. 3	May 15	45.6
Vineland	Oct. 18	Apr. 17	Oct. 2	May 13	47.3
Atlantic City	Nov. 4	Apr. 11	Oct. 1	Apr. 25	42.0

Production of Fruits in New Jersey

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 2,372,000 bushels, valued at $1,975,000. Apples contributed nearly three-fifths of this quantity, peaches and nectarines and pears most of the remainder. The production of grapes amounted to 6,501,000 pounds, valued at $133,000, while the production of nuts and of tropical fruits was relatively unimportant.

The production of all orchard fruits together in 1909 was 61.5 per cent less in quantity than that in 1899, while the production of grapes increased. The value of orchard fruits declined from $2,595,000 in 1899 to $1,975,000 in 1909, while that of grapes increased from $81,758 in 1899 to $132,957 in 1909.

It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	.....	3,165,749	.....	2,190,236	2,372,358	$1,975,044	6,168,480
Apples	21,127	1,053,626	5,851	519,749	1,406,778	956,108	4,640,896
Peaches and nectarines	5,783	1,216,476	5,493	1,363,632	441,440	652,771	620,928
Pears	11,078	731,616	3,439	238,401	463,290	254,582	790,818
Plums and prunes	4,052	46,547	1,714	23,071	9,594	13,476	24,685
Cherries	8,101	102,124	1,928	36,743	44,636	87,225	82,005
Apricots	214	582	125	504	178	299	201
Quinces	2,731	14,777	876	8,134	6,442	10,583	(2)
Mulberries	1	1	1	2	.....	.....	(2)
Unclassified			.....	.....	.....	.....	[3] 8,947
Grapes	5,368	1,603,280	1,295	558,945	6,501,221	132,957	4,235,000
Nuts, total	.	[4] 22,764	.....	[4] 3,557	[4] 249,626	[4] 7,116	947,950
Black walnuts	1,072	4,168	139	804	151,828	2,766	(2)
Chestnuts	206	14,752	42	1,094	25,987	1,413	(2)
Hickory nuts	353	3,066	13	103	62,243	2,468	(2)
Unclassified	.		.....	.....	.....	.....	[3] 947,950
Tropical Fruits, total [5]		77	....	19	.....	204	..
Figs	11	75	3	19	939	202	....

[1] Expressed in bushels for orchard fruits and persimmons, and pounds for grapes, nuts and figs.

[2] Included with "unclassified."

[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."

[4] Includes Persian or English walnuts, almonds, pecans, Japanese walnuts, beechnuts, Japanese chestnuts, filberts, butternuts hazelnuts and other nuts.

[5] Includes small amount of Japanese persimmons.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	2,618	7.8	Gals.	288,587	917,973
Vinegar	693	2.1	Gals	48,665	197,694
Wine and grape juice	1,072	3.2	Gals	233,880	123,454
Dried fruits	68	0.2	Lbs.	6,323	14,860

New Mexico

The main body of New Mexico is an elevated plain ranging from 3,000 feet to 7,000 feet in height. From this tableland rise mountain peaks, among which are Sierra Blanca, 14,269 feet; Truchas, 13,150 feet; Taos, 13,145 feet; Costilla, 12,634 feet; Baldy, 12,623 feet; Lake, 12,380 feet, and Mora, 12,623 feet.

The streams of the eastern and central parts flow into the Mississippi river and the Gulf of Mexico, while those of the western part flow into the Gulf of California. The principal rivers are the Rio Grande, Pecos and the Canadian, flowing to the eastward, and the San Juan, Zuni and Gila, flowing westward.

The state lies within the arid regions, but the lands are fertile. Wherever there is sufficient moisture either by irrigation or otherwise they are very productive. Portions of the state are very well adapted to fruit growing. Among these portions are those near Santa Fe, Albuquerque and Deming. It is considered that lands with good air drainage and sufficient water and not more than 7,000 feet high are adapted to fruits. There is very little crop-growing of any kind without irrigation. The soil contains a supply of mineral elements that makes it well adapted to horticulture, and some soil chemists believe that insofar as their fertility is concerned they are inexhaustible.

New Mexico has but little timber. On the mountains there is a considerable growth of fir, spruce and pine, and lower down cedar, nut-pine and mesquite. Occasionally along the streams may be found oak, ash, walnut, cottonwood and sycamore. The principal growths are the many species of yucca and cactus, found in the arid regions where the climate is not too cold.

Climate

The temperature is mild, seldom falling below the freezing point, and not often rising to extreme heat, owing to the elevation. The average rainfall is about ten inches, which for the most part makes farming or fruit growing without irrigation impossible.

Irrigation is carried on largely by means of canals, but there are places where irrigation is from wells, if water can be obtained without too much expense, and in sufficient quantities to make this method profitable.

The fruit-growing districts are in the valleys, largely because they can be more easily irrigated and because they are better protected from frosts and winds.

T. D. A. Cockerell has divided the state into zones, as follows:

1. Canadian zone: from 8,000 to 9,000 feet, where Irish potatoes can be grown.
2. Transition zone: where deciduous fruit trees, small fruits and sugar beets can be successfully grown. This is at an elevation of about 7,000 feet.
3. Upper Sonora zone: at about 5,000 to 6,000 feet, as around Albuquerque. In this zone European grapes, peaches and sweet potatoes are successfully grown, but apples do not succeed so well.
4. Middle Sonora zone: somewhat warmer than the upper Sonora and therefore more inclined to the "semi-tropical."

Parker Earle thinks that the apples that reach the highest degree of perfection in New Mexico are the Yellow Bellflower and Newtown Pippin, especially is this true in the counties of Chaves and Lincoln.

The apple is the most important fruit grown in the state, and second in impor-

tance is the peach. The peaches are best adapted to the lower valley, and from Mesilla large quantities are shipped to the Eastern markets.

Apricots, plums, grapes, quinces and pears do well in the different localities suited to them.

Prof. Fabrian Garcia says:

*"New Mexico, though lying pretty well south and frequently thought to be out of the apple-growing belt, contains many sections well adapted to apple culture. Almost every county in the territory has demonstrated this fact. A very important factor governing apple culture in New Mexico is water. If more water for irrigation purposes could be secured, especially for high land, more apple orchards could be planted. Because of the large area and great difference in altitude a great variety of climatic and soil conditions exist. The apple will grow in any part of the territory where enough moisture may be had for it, but the same varieties may not be equally suited to all of the apple growing districts; neither can the same cultural methods or irrigation practices always be applied.

The largest apple growing sections are found in the larger valleys and in the mountains where mountain streams can be utilized for irrigation. Many of these sections are comparatively new and small, but there is no doubt that just as soon as some of the many irrigation schemes now under way are completed, the apple-growing area of the territory will be increased. The apple is undoubtedly the most important orchard fruit in New Mexico and it is likely that it will always be, because it can be shipped long distances."

GRANVILLE LOWTHER

Varieties Adapted to New Mexico

The question of recommending varieties is always a difficult one, but judging from the results at the station and from observations made by the writer in the territory and from reports of different growers in New Mexico the following varieties are given as being among the best of those that have fruited. These have been classified in groups for the different sections or counties. The location of these divisions may be found in figure 9. These are the most important apple growing districts in the territory at present.

GENERAL COLLECTION. Ben Davis, Gano, Mammoth, Black Twig, Missouri Pippin, Winesap, Rome Beauty, Jonathan, Grimes Golden, W. W. Pearmain, Northern Spy, Geniton, Arkansas Black, Black Ben Davis, Maiden's Blush, Yellow Transparent, Red Astrachan, Red June, and Early Harvest.

GROUP I. Satisfactory varieties reported from the Mimbres valley, in southwestern New Mexico: Early—Red Astrachan, Red June, and Early Harvest. Late—Black Ben Davis, Winesap, Delicious, Paragon, and Arkansas Black.

GROUP II. Satisfactory varieties reported from the Rio Grande valley from north of Bernalillo to the Texas line. Early—Maiden's Blush, Red June, Early Harvest, Yellow Transparent. Late—Ben Davis, Arkansas Black, Missouri Pippin, White Winter Pearmain, Mammoth Black Twig, Winesap, and Jonathan.

GROUP III. Satisfactory varieties reported from Otero county districts: Early—Yellow Transparent. Late—Mammoth Black Twig, Ben Davis, Winesap, W. Winter Pearmain, Jonathan, Arkansas Black, and Rome Beauty.

GROUP IV. Satisfactory varieties reported from the Lincoln county region: Early—Maiden's Blush, Red June. Late—Mammoth Black Twig, Winesap, W. W. Pearmain, Geniton, and Northern Spy.

GROUP V. Satisfactory varieties reported from the Pecos valley: Early—Maiden's Blush, Yellow Transparent, Red June, Early Harvest, and Strawberry. Late—Ben Davis, Black Ben Davis, Mammoth Black Twig, Winesap, Jonathan, Arkansas Black, Grimes Golden, and Missouri Pippin.

GROUP VI. Satisfactory varieties reported from Colfax county: Early—Maiden's Blush and Early Harvest. Late—Ben Davis, Jonathan, Northern Spy, and Geniton.

GROUP VII. Satisfactory varieties re-

* New Mexico Experiment Station Bulletin No. 75.

ported from San Miguel county: Early—Maiden's Blush. Late—Ben Davis, and Northern Spy.

GROUP VIII. Satisfactory varieties reported from Santa Fe and Rio Arriba counties: Early—Maiden's Blush, Early Harvest, and Red June. Late—Ben Davis, Winesap, Jonathan, Gano, Rome Beauty, Mammoth Black Twig, Missouri Pippin, Chenango, and Arkansas Black.

GROUP IX. Satisfactory varieties reported from Taos county. Early—Early Harvest, Strawberry, and Yellow Transparent. Late—Ben Davis, Jonathan, W. W. Pearmain, Rome Beauty, Stayman Winesap and Limber Twig.

GROUP X. Satisfactory varieties reported from San Juan county. Early—Red June and Maiden's Blush. Late—Ben Davis, Winesap, Jonathan, Grimes Golden, Rome Beauty, W. W. Pearmain and Janet.

GROUP XI. Varieties most widely grown in New Mexico. Early—Maiden's Blush, Yellow Transparent, Red June and Early Harvest. Late—Ben Davis, Mammoth, Black Twig, Gano, Winesap, Jonathan, W. W. Pearmain, Arkansas Black, Rome Beauty and Missouri Pippin.

GROUP XII. New varieties that are giving satisfactory results wherever they have been planted. Black Ben Davis, Paragon, Delicious and Senator.

A great many of the newer varieties, such as the Raspberry, Ingram, Champion, Red Akin, King David, Ben Hur, Bismarck, Stayman Winesap, Stark, Springdale, are now being planted in New Mexico, but it is yet too early to say anything definite about their adaptability to this section.

Frosts and Precipitation in New Mexico

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Aztec	Oct. 2	May 4	Sept. 19	May 20	8.1
Santa Fe	Oct. 19	Apr. 15	Sept. 25	May 18	14.2
Fort Union	Oct. 5	May 20	Oct. 11	June 4	18.2
Albert	Oct. 23	Apr. 16	Oct. 13	May 3	15.7
Ft. Wingate	Oct. 2	May 12	Sept. 12	May 27	13.9
Albuquerque	Oct. 22	Apr. 8	Sept. 17	Apr. 23	7.2
Roswell	Oct. 22	Apr. 15	Oct. 14	Apr. 30	15.8
Ft. Bayard	Oct. 19	Apr. 27	Oct. 3	May 4	13.8
Mesilla Park	Oct. 26	Apr. 22	Oct. 20	May 22	9.4

Production of Fruits in New Mexico

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	.....	66	48	76,532	$9,335
Strawberries	54	20	9	35,634	4,086
Blackberries and dewberries	54	10	3	10,089	1,698
Raspberries and loganberries	50	12	9	10,222	1,581
Currants	74	7	10	5,523	591
Gooseberries	125	17	12	14,800	1,348
Cranberries	1	(1)	....	96	10
Other berries	4	(2)	5	168	21

[1] Less than 1 acre.
[2] Reported in small fractions.

The total production of small fruits in New Mexico in 1909 was 76,532 quarts and in 1899, 69,690, and the value was $9,335 in 1909, as compared with $5,768 in 1899. The most important of the small fruits in 1909 were strawberries.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	.....	803,068	.....	1,282,211	504,059	$519,677	267,835
Apples	5,242	542,528	5,489	914,254	417,143	420,536	142,332
Peaches and nectarines	2,982	136,191	4,094	184,466	32,533	37,195	76,204
Pears	2,093	37,220	2,718	100,201	29,435	29,688	14,777
Plums and prunes	2,476	51,257	2,877	42,351	15,528	17,054	18,492
Cherries	1,916	21,925	2,234	26,818	6,384	10,684	5,228
Apricots	1,368	8,202	965	8,373	2,379	3,446	6,637
Quinces	422	5,735	244	3,183	657	1,074	(2)
Mulberries	1	10	41	2,565	....	....	(2)
Unclassified	....	....	....	....	....	....	[3] 4,165
Grapes	820	250,076	1,390	122,367	425,415	16,101	1,515,900
Nuts	.....	[4] 503	....	[4] 5,199	[4] 1,498	[4] 195	5,380
Tropical Fruits, total	.	116	....	319	.....	192	....
Figs	30	103	23	317	2,820	167	30
Oranges	2	13	1	2	12	25	....

[1] Expressed in bushels for orchard fruits, pounds for grapes, nuts and figs, and boxes for oranges.

[2] Included with "unclassified."

[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."

[4] Includes Persian or English walnuts, almonds, pecans, black walnuts, butternuts, filberts, Japanese walnuts, chestnuts, hazelnuts and hickory nuts.

The total quantity of orchard fruits produced in 1909 was 504,000 bushels, valued at $520,000. Apples contributed about four-fifths of this quantity. The production of grapes in 1909 was 425,000 pounds, valued at $16,101, while that of nuts and of tropical fruits was unimportant.

The production of all orchard fruits together in 1909 was 88.2 per cent more in quantity than that in 1899, while the production of grapes decreased decidedly. The value of orchard fruits increased from $197,000 in 1899 to $520,000 in 1909, while that of grapes declined from $33,717 in 1899 to $16,101 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	100	0.3	Gals.	12,788	20,633
Vinegar	55	0.2	Gals.	5,880	17,514
Wine and grape juice	9	(1)	Gals.	1,684	34,208
Dried fruits	74	0.2	Lbs.	16,506	10,550

1 Less than one-tenth of 1 per cent.

New York

New York state is most fortunately situated in relation to markets and transportation. It touches the Atlantic seaboard on the east and the Great Lakes on the west. The Hudson river is navigable for considerable distance inland, and the railroad and electric lines penetrate all the good farming districts.

New York city has a population, according to the census of 1910 of 4,776,883, while the state as a whole had 9,113,614. The mountain features of the state are a continuation of the Appalachian range and the Adirondacks. Most of the best farming lands are west of the mountains; however, in the mountain regions are small rich valleys and on the Atlantic coast are considerable areas of level or undulating lands which produce well, and being near the best markets are of considerable value.

The best fruit-growing district, according to present statistics, is along the lakes on the west, and the next best district is along the Hudson river. However, scattered throughout the state are many small lakes such as Canandaigua, Skaneateles, Cayuga, Seneca, Oneida, Onondaga and others of glacial origin, and with sufficient bodies of water to protect the fruit in some degree from frost. In these sections the soil and climate are adapted to the growing of fruits and the industry is profitable.

New York state was settled more than 100 years ago. The hardy pioneers cleared the land, built cabins, made farms and planted orchards. There are apple and pear trees in almost all parts of the state planted by these first families, trees that are 100 years old and still in bearing. Of course, as compared with the number of trees planted, the number that live to be 100 years old are a little like the number of the human family who live to be the same age. Trees that live to such an age first of all are of vigorous stock; then they must be favorably situated with reference to soil and climate.

It is interesting to note under what conditions an apple or a pear tree will live and bear fruit for 100 years. In every case I have examined there has been a deep soil which enabled the roots to penetrate to sufficient depth to obtain an abundance of food. Further, there has been sufficient water. Generally there was drainage from the hillsides above and toward the trees, and a gravelly or sandy subsoil, that insured good drainage away from the roots. The mixture of clay loam, sandy loam and gravelly loam found so often in the glacial deposits of New York are favorable conditions for the growing of trees of large size and long life. There are considerable areas in New York state where there is a strong admixture of limestone, and this adds to its value for general farming, as well as for the growing of fruits.

In a review of the state of New York, Long Island deserves special mention. It occupies about one-twentieth of the state, begins at a point near New York city, is about an average of 16 miles wide and 125 miles long. It extends in a northeasterly direction along the coast of Connecticut, and being entirely surrounded by the waters of the Atlantic ocean, is well protected from frosts. According to Professor F. W. Hooper, it has about the same area and population as Holland, yet the produce taken out of the soil of Holland is 21 times as great as that taken out of the soil of Long Island. He

does not say whether he thinks the soil of Long Island is naturally as fertile as the soil of Holland, but evidently from his report he thinks it can be made so. In order to remedy this lack of productivity, the Long Island Railroad Company established, in 1905, an experiment station that brought to the people such favorable results that the state is now establishing a station designed to accommodate 1,000 students.

The soils of this island consist of stony loams, sandy loams and sands along the glacial morains forming the northern and central portions of the high lands. Sloping from these morains down to the sea level the soils are of much the same character with a larger percentage of sands as "glacial outwash." All of these soils with proper treatment are adapted to the growing of fruits and vegetables, and being so near the markets are at an advantage as compared with the sections of the country farther away.

The best apple-growing counties are Duchess, with 303,105 bearing trees; Erie, 472,932; Genesee, 300,865; Monroe, 702,840; Ontario, 369,050; Orleans, 549,749; Wayne, 812,410. With the exception of Duchess, which is located in the southeast, and Ontario, located in the central west and affected by several small lakes the largest of which are Seneca and Canandaigua, the greatest apple-growing counties are in the west and northwest in a glacial soil or a part of the old lake bed, with the climate tempered by the waters of the lakes. The greatest peach-growing districts are Monroe and Niagara in the west with 339,375 and 591,350 trees respectively and Ulster in the southeast near the Hudson river with 313,350 bearing trees.

The greatest grape-growing sections are the counties of Chautauqua with 15,782,646 vines; Erie, 1,141,278; Ontario, 1,831,644; Ulster, 1,969,301; Yates, 5,123,572.

The largest acreage of strawberries is in the counties of Erie, 596, and Ulster, 895. Oswego had in the past the greatest acreage of strawberries, but according to the last census several other counties are ahead of it.

All of the hardy fruits can be grown in New York, and, on account of its relation to waters that modify the atmosphere, some of the fruits that are of the tender varieties are grown.

New York has sent out more literature on fruits than any other state in the Union. Special mention should be made of the book entitled the "Apples of New York," and of the voluminous writings of Professor L. H. Bailey, of Cornell University, who has ably and scientifically treated almost every phase of the agricultural and horticultural field. According to Professor Bailey, the apple best adapted to New York is the Baldwin, "and it has no close second." The Northern Spy, Rhode Island Greening and American Golden Russet, are important commercial varieties.

In the number of bearing fruit trees of all kinds, Missouri stands first, California second and New York third. In the value of orchard crops, California is first and New York second.

GRANVILLE LOWTHER

Origin and Development of Apple Culture in New York

We are indebted to S. A. Beach, N. O. Booth and O. M. Taylor, horticulturists of New York, in the "Apples of New York," for the following history of apple culture in that state:

"The principal native fruits of New York, in addition to the wild crab, are the wild strawberries, red raspberries, black raspberries, dewberries, blackberries, elderberries, cranberries, huckleberries, blueberries, the beach plum along the coast, the wild red or Canada plum along the valley of the St. Lawrence, the wild red or yellow plum of Central or Southern New York, the fox grapes in the eastern or southeastern part of the state, the summer grape of the southern counties, and the river bank or frost grape of general distribution. Improved varieties of the native grapes and of many of the small fruits are now extensively grown both for home use and for the market, but so far as New York state is

concerned this does not hold true of any of the orchard fruits. Some of the native plums are cultivated in the northern counties to a very limited extent, but generally speaking, New York orchard fruits are all of old world species.

Introduction of the Apple

"In view of the primitive character of our native fruits, it is but natural that when the Europeans began to form settlements on this continent they should bring their favorite fruits with them from the old world. This they did. Some few brought trees or scions of choice varieties, but more followed the less expensive plan of bringing seeds of selected fruits to plant about their new homes in America, just as their descendants of recent times have continued to do when leaving the older settlements of the East to take up pioneer life along the frontier of civilization.

"The introduction of the apple into New York, along with other old world fruits began nearly 300 years ago. In the following years at one time or another, very many of the cultivated varieties of Western Europe were brought here and this importation has been kept up with each succeeding generation till the present time. In the earliest settlements doubtless the first varieties which were brought into New York were mostly from Holland. Later some came from France, Germany and other continental countries and many from the British Isles, either directly or through neighboring colonies.

The Early Dissemination of the Apple

"When once the apple was introduced its dissemination kept pace with the progress of the settlement of the country. In fact it was carried by Indians, traders and white missionaries far into the wilderness beyond the uttermost white settlements. Reports of General Sullivan's expedition in 1779 against the Cayugas and Senecas, in describing the Indian villages which were then destroyed, make frequent mention of peach and apple orchards that were found bending with fruit. Within sight of the Geneva Experiment Station are two very old apple trees, the only ones in this vicinity now left of the many hundreds which the Indians were growing in the clearings about their town of Kanadesaga, which was located there.

The Apple Now Grows Wild in New York

"The apple is notably abundant along fence rows and in hill pastures in Southern and Southeastern New York, and on the Onondaga limestone formations in Onondaga and Madison counties. Some of these are superior to some of the cultivated varieties now grown for commercial purposes.

Primitive Orchards

"As the early settlements gradually extended back from the Atlantic coast region, the pioneers who overspread the interior of New York, hewing farms out of the forest, planted around their new homes apple seeds brought from the older settlements or from Europe.

"In many parts of New York, especially in the eastern two-thirds of the state, there are still seen portions of the primitive seedling orchards varying in age from 50 to 100 years, possibly more. The old trees having outlived their companions stand as silent reminders of the stage coach, hand loom, spinning wheel, the paring bee, and of the time when the farmer generally considered his winter supplies incomplete unless there were several barrels of cider stored in the cellar. Peter W. Yates writing in 1803, says:

"'The practice of grafting and inoculating fruit trees in America is but of modern date. It was introduced by Mr. Prince, a native of New York, who erected a nursery in its neighborhood about 1760. But since the American Revolution, others have been instituted in this and some other parts of the United States. Mr. Livingstone has lately established one, not far from the city of New York, which can vie with some of the most celebrated ones in Europe.'

"Although this idea that grafting and budding were introduced into America

by Mr. Prince is based upon a misapprehension of the facts, Mr. Yates' statements are of interest because they tend to show that prior to the Revolutionary war the planting of grafted trees from the nursery was not common in the vicinity of Albany, one of the oldest settlements in the state. Taylor says: 'Certain it is that in 1647 the apple is recorded as grafted on the wild stocks in Virginia. Grafting was also practiced in New England at an earlier date than that recorded by Mr. Prince.'

Commercial Orchards

"The development of domestic and foreign commerce in apples and apple products such as dried apples, cider, apple brandy and vinegar, naturally first assumed importance in New York in the vicinity of New York city because this was the metropolis and seaport. Speaking of the beginning of the foreign trade in this country in fruits, Taylor remarks: 'Trade in this fruit with the West Indies probably developed early in the eighteenth century, though we have no record of shipments till 1741, when it is stated apples were exported from New England to the West Indies in considerable abundance. No transatlantic shipment has been disclosed earlier than that of a package of Newtown Pippins of the crop of 1758 sent to Benjamin Franklin while in London. The sight and taste of these brought to John Bartram, of Philadelphia, an order for grafts of the variety from Franklin's friend Collison, who said of the fruit he ate: "What comes from you are delicious fruit—if our sun will ripen them to such perfection." Subsequently a considerable trade must have resulted, for in 1773 it was stated by the younger Collison that while the English apple crop had failed that year, American apples had been found an admirable substitute, some of the merchants having imported great quantities of them.'

"Statistics are lacking until 1821, when the total export of fruit under the treasury statement consisted of 68,443 bushels of apples valued at $39,660.

"It was not until after the first quarter of the nineteenth century had passed that commercial apple culture began to be developed in New York to any considerable extent above the southern part of the Hudson valley.

"As transportation facilities gradually improved by the opening of canals and railways the farmers in many interior localities found that they could send their fruit to other than local markets and receive profitable returns. Accordingly commercial orcharding began to attract attention, especially in the regions which were found to be naturally favorable for the production of good apples. From 1850 to 1860 the number of commercial orchards which were planted increased rapidly, particularly in Western New York, and continued to increase thereafter till commercial apple orcharding assumed the important place which it now holds in the horticultural interests of the state.

"With the development of commercial apple interests the losses from the depredations of codling moth and other insects, also from apple scab and other fungous diseases, became relatively more important. Commonly the causes of the losses which were sustained were not very well understood and in those cases that were understood there appeared no practical remedy. Because of these and other difficulties which faced them some orchardists became so discouraged at the outlook that in a decade from 1880 to 1890 they began to cut down their commercial apple orchards. The practical use in the orchard of Paris green and other arsenical poisons against the codling moth, the canker worm and other leaf-eating insects, originated in most part in Western New York in the decade from 1870 to 1880. (See Lodeman, 'Spraying of Plants,' 61-62.) The use of fungicidal sprays was introduced in the decade between 1885-1895. The demonstration that by combined treatment with fungicides and insecticides, some of the most destructive enemies of the apple might be profitably kept under control put the business of growing apples upon a more stable basis than before. In the decade

from 1890 to 1900 notable improvements in the methods of orchard management in matters of tillage and cover crops came into vogue among progressive commercial orchardists. During the same period the facilities for holding apples both in common storage and cold storage were greatly increased. The export trade developed more extensively, giving steadier markets for the better grades of fresh fruits and also of evaporated apples, and the business of canning apples assumed considerable importance. Upon the whole the industry of growing apples now rests upon a more stable and satisfactory basis than at any period in its previous history.

Varieties Now in the Lead

"In 1896 the writer, assisted by Prof. C. P. Close, made an inquiry as to what varieties were then grown most extensively throughout the state and their relative hardiness. During the present year many inquiries have been made also among fruit growers of the state concerning the varieties that are being grown, as to their relative importance and characteristics. From these and other data it appears that the Baldwin ranks preeminently above any other kind of apple in importance in the commercial orchards of the state. Probably more Baldwin apples are put upon the market than all other kinds combined. Rhode Island Greening ranks next in importance It is doubtless speaking within bounds to say that these two varieties supply at least two-thirds of the apples grown for market in New York. Next in general importance comes the Northern Spy.

The relative rank of other varieties is not so easily determined, but in the following list those of more general importance precede those of less importance, although it may not be in exact order. Among the most important kinds besides the three just named, are Tompkins King, Roxbury Russet, Golden Russet, Hubbardston, Esopus Spitzenburg, Black Gillflower, Ben Davis, Tolman Sweet, Twenty Ounce, Pumpkin Sweet, Swaar, Westfield Seek-No-Further, Fameuse, Fall Pippin, Yellow Bellflower, Yellow Newtown, Green Newtown, Jonathan, Red Astrachan, Oldenburg, Maiden Blush, Wealthy, McIntosh, Gravenstein, Alexander, Early Harvest, Yellow Transparent, St. Lawrence, Blue Pearmain.

Adaptation of Varieties to Particular Regions

"It is worthy of notice that the apples in the above list which are of dominant importance in the present-day commercial orchards of New York, are of New York and New England origin. Baldwin, Roxbury and Hubbardston came from Massachusetts; Rhode Island Greening and Tolman Sweet came from Rhode Island; Twenty Ounce, Pumpkin Sweet and Seek-No-Further are from Connecticut; Fall Pippin is probably from Eastern New York; Tompkins King is said to have originated in New Jersey, but was first brought to notice in Central New York; Esopus Spitzenburg, Jonathan and Swaar, originated in the Hudson valley; Green Newtown Pippin and Yellow Newtown Pippin on Long Island; Early Harvest in Central New York; Yellow Bellflower and Maiden Blush in New Jersy; Fameuse, McIntosh and St. Lawrence, in Canada; Red Astrachan, Alexander, Oldenburg and Gravenstein in Russia or Germany. Only one of the list, the Ben Davis, comes from south of the Mason and Dixon line, and this one succeeds better in the South and Southwest than it does in New York. While the Yellow Newtown Pippin, under the name of Albemarle Pippin, has become a very important commercial variety in some portions of the South, yet a case like this is exceptional.

"The Baldwin, which in New York is a standard winter variety, becomes a fall apple in Virginia and Arkansas. Varieties like the Ben Davis, Grimes Golden and York Imperial require a warmer and a longer period for their development than do such apples as Baldwin, Rhode Island Greening and Tompkins King, therefore, these can never become standard sorts in Central and Western New York by reason of climatic conditions. But the adaptability of a

variety to a particular region is not altogether a matter of latitude, or length of seasons. The general character of the soil, the prevailing climatic conditions during the blooming season, and other conditions peculiar to local environment also enter into the question. Probably there is no region of New York where better Esopus Spitzenburgs are grown than in the Schoharie valley; or better Newtown Pippins than in certain locations on the north shore of Long Island and in the Hudson valley; or better Fameuse than along the St. Lawrence river and Lake Champlain, yet there are locations having corresponding latitude and altitude where these kinds do not succeed as in the regions named."

Frost and Precipitation in New York

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Ogdensburg........	Oct. 8	Apr. 26	Sept. 23	May 19	30.7
Saranac Lake......	Sept. 14	May 22	Aug. 21	June 11	35.6
Lowville...........	Sept. 24	May 14	Sept. 6	May 29	36.4
No. Four	Sept. 23	May 24	Sept. 9	June 10	50.4
Appleton..........	Oct. 13	May 7	Sept. 23	June 5	32.7
Rochester.........	Oct. 19	May 1	Sept. 26	May 30	34.5
Oswego............	Oct. 13	Apr. 25	Oct. 3	May 29	36.8
Rome.............	Sept. 30	May 10	Sept. 1	June 7	47.9
Glens Falls........	Oct. 6	May 10	Sept. 14	May 25	40.5
Buffalo............	Oct. 16	Apr. 25	Sept. 23	May 23	37.4
Avon..............	Oct. 3	May 15	Sept. 15	May 31	27.0
Auburn............	Oct. 12	May 4	Oct. 2	May 15	36.7
Cooperstown	Oct. 1	May 7	Sept. 15	May 27	39.9
Albany....	Oct. 18	Apr. 24	Oct. 3	May 30	36.9
Jamestown.........	Oct. 2	May 4	Sept. 15	May 29	44.2
Angelica...........	Sept. 24	May 22	Sept. 1	June 21	37.9
Ithaca	Oct. 11	May 2	Sept. 15	May 29	34.4
Honey Mead Brook	Oct. 9	Apr. 30	Sept. 25	May 23	43.2
Port Jarvis........	Oct. 7	Apr. 29	Sept. 15	May 17	46.2
New York.....	Nov. 6	Apr. 10	Oct. 15	Apr. 30	44.8
Setanket.....	Nov. 10	Apr. 15	Oct. 22	May 17	48.5

Synopsis of Fruit Production in New York

The following statement of the fruit production of New York, by comparison, is taken from Bulletin 48, entitled "Fruit Production of New York." The bulletin is written by George G. Atwood, Chief of the Bureau of Horticulture and Nursery Inspection.

Fruit growing in the state of New York has assumed such large proportions and has been pursued so long that it is away beyond the experimental stage. There is no state where conditions are more favorable or where the industry is so firmly established. Soil, climate and proximity to the best markets of the world are ours and it only remains for growers to apply their knowledge to succeed.

The value of all fruit produced in the state of New York according to the last census is as follows: $24,826,066.

Apples	$13,343,028
Peach	2,014,088
Pear	1,418,218
Plum	519,192
Cherry	544,508
Apricot and nectarine	14,490
Quince	135,345
Total value of orchard fruits	$17,988,894
Value of small fruits	2,875,495
Value of grapes	3,961,677
	$24,826,066

The value of all fruit produced in New York state exceeds the value of the tropical and sub-tropical fruits produced in the United States by $2,144,618.

New York has a total of 24,988,707 orchard trees which produce 29,456,291 bushels, valued at $17,988,894.

New York ranks third, exceeded by California and Missouri in number of trees.

New York ranks second in bushels of fruit produced, exceeded by California by about 2,045,216 bushels, because of their immense prune industry.

New York has 14,076,718 apple trees which produce 25,409,324 bushels valued at $13,343,028.

New York ranks first in the value of apples; first in bushels produced and second in number of trees. Missouri ranks first in the number of trees with 17,984,506, but with a production of 9,968,977 bushels.

New York has 3,644,257 pear trees which produce 1,343,089 bushels valued at $1,418,218.

New York ranks first in the number of trees; second in the quantity and value produced, closely following California in this respect.

New York ranks third in value of peaches produced, about equal to Georgia and less than half the value produced in California.

New York ranks third in the value of plums and prunes, producing $519,192; Washington producing $600,503, and California, with its enormous prune industry, producing $5,443,539.

New York has 309,734 quince trees which produce 132,451 bushels, valued at $135,345.

New York ranks first, as it produces about one-fourth of the quinces raised in the United States.

New York has 35,603,897 grapevines in vineyards which produce 253,006,361 pounds, valued at $3,961,677.

New York ranks second in number, production and value of vines, while California ranks first with a production of $10,846,812.

New York produced $2,867,673 in flowers and plants, thus ranking first.

New York produced $2,750,957 in nursery products, thus placing it in first rank.

New York has 22,496 acres in small fruits producing 37,857,829 quarts, ranking second, but closely following New Jersey which is first in small fruits.

New York ranks first with 11,057 acres in raspberries, and first in currants with 2,557 acres.

The following was furnished by this department for the "Arbor Day Annual" issued by the Education Department in 1912.

Production of Fruits in New York

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	....	22,496	25,051	37,857,829	$2,875,495
Strawberries	14,086	6,382	7,311	15,945,863	1,187,410
Blackberries and dewberries	4,882	1,951	2,060	2,509,851	210,986
Raspberries and loganberries	13,187	11,057	12,376	14,751,940	1,168,062
Currants	7,528	2,557	2,594	3,982,389	264,051
Gooseberries	1,696	259	190	331,135	23,427
Cranberries	88	277	113	327,370	20,743
Other berries	9	13	407	9,281	816

Strawberries and raspberries and loganberries are by far the most important small fruits grown in New York, with currants ranking next. The total acreage of small fruits in 1909 was 22,496 and in 1899, 25,051, a decrease of 10.2 per cent. The production in 1909 was 37,858,000 quarts, as compared with 40,376,000 quarts in 1899, and the value $2,875,000, as compared with $2,538,000.

Orchard fruits, grapes, nuts, and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts, and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product 1909		Product 1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	...	17,625,093	...	7,363,614	29,456,291	$17,988,894	26,172,310
Apples	168,667	11,248,203	48,007	2,828,515	25,409,324	13,343,028	24,111,257
Peaches and nectarines	25,926	2,457,187	14,337	2,216,907	1,736,483	2,014,088	466,850
Pears	85,725	2,141,596	26,773	1,502,661	1,343,089	1,418,218	960,170
Plums and prunes	62,024	919,017	22,083	328,329	553,522	519,192	303,688
Cherries	59,408	673,989	20,087	342,959	271,597	544,508	218,642
Apricots	2,033	16,050	767	3,537	9,805	14,490	15,710
Quinces	12,280	169,031	3,404	140,703	132,451	135,345	(2)
Mulberries	11	20	2	3	20	25	(2)
Unclassified	...	...	...	...	...	...	[3] 95,993
Grapes	34,256	31,802,097	7,250	3,801,800	253,006,361	3,961,677	247,698,056
Nuts, total	...	[4] 164,333	...	[4] 51,239	[4] 2,773,858	[4] 74,420	3,451,550
Persian or English walnuts	81	456	28	139	9,346	858	...
Black walnuts	2,815	19,782	428	27,591	465,918	11,485	(2)
Butternuts	4,623	36,456	447	5,175	1,519,279	21,631	(2)
Chestnuts	1,797	72,976	198	12,841	286,227	23,589	(2)
Hickory nuts	3,142	34,309	220	5,381	487,768	16,742	(2)
Unclassified	...	...	...	...	...	...	[3] 3,451,550
Tropical Fruits (figs)	12	21	8	25	...	5	...

[1] Expressed in bushels for orchard fruits and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes small amounts of almonds, pecans, hazelnuts, beechnuts, Japanese chestnuts, Japanese walnuts, filberts and other nuts.

The total quantity of orchard fruits produced in 1909 was 29,456,000 bushels, valued at $17,989,000. Apples contributed about six-sevenths of this quantity, peaches and nectarines and pears muost of the remainder. The production of grapes in 1909 amounted to 253,006,000 pounds, valued at $3,962,000; that of nuts to 2,774,000 pounds, valued at $74,000.

The production of all orchard fruits together in 1909 was 12.5 per cent greater than that in 1899, while the production of grapes increased 2.1 per cent. The value of orchard fruits increased from $10,542,000 in 1899 to $17,989,000 in 1909, and that of grapes from $2,764,000 in 1899 to $3,962,000 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The next table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	54,168	25.1	Gals.	5,191,221	4,597,519
Vinegar	13,547	6.3	Gals.	703,384	574,875
Wine and grape juice	1,823	0.8	Gals.	346,973	290,365
Dried fruits	1,290	0.6	Lbs.	4,385,978	3,658,610

NITROGEN, GAIN OF, PER ACRE AND MARKET VALUE. See *Soils.*

NITROGEN. See *Apple Orchard, Fertilization of.*

North Carolina

North Carolina is about as large as England, and in size, is the seventeenth state in the Union. It is divided naturally into three parts, namely, the eastern part which is level and swampy; the central part or hilly region; and the western part which is mountainous.

The eastern division was once a part of an ocean bed, and now contains many deposits of sand which are shifted by the winds and storms. In the western portion, the highest elevation is Mount Mitchel, which is 6,688 feet above the sea, the highest east of the Rocky mountains. There are no less than 24 peaks higher than Mount Washington, which is the highest peak in the White mountains, and with the exception of the mountains of North Carolina, is the highest east of the Rocky mountains.

The climate is mild, though somewhat varied, on account of the different degrees of elevation. It is on the same isothermal line as California, Southern France and Northern Italy.

The temperature of the lowlands is hot and humid, but in the interior, especially in the Piedmont and mountain section, the air is singularly pure, dry and elastic. The mean annual temperature at Raleigh is 60 degrees, at Asheville 50 degrees, at Wilmington 63 degrees. The average rainfall is from 45 to 58 inches, depending on the point of observation. In the northern portion there are sometimes severe frosts, which must be taken account of in the planting and growing of commercial fruits.

Notwithstanding that the eastern part along the coast is in a considerable degree sandy, along the rivers is a rich clay loam, and occasional swamps. About these swamps are beds of peat, and it was from one of these beds that the boy who is now called "The Corn King" obtained the fertilizers that enabled him to produce the corn which won the prize at the Interstate Contest, for the largest yield, and the best quality of corn, grown on one acre in the United States. On land that had formerly grown 26 bushels per acre, this boy, by the aid of fertilizers, grew 212 bushels, thus proving that North Carolina has within her own borders a fertilizer that will make her worn-out lands of exceeding value.

North Carolina is well adapted to fruits, because it has a good soil, good air drainage in the hill and mountain regions, and a mild climate. However, there is a great deal of cloudy weather, and on this account certain fungous diseases are more prevalent, and apples, peaches, and the fruits that are prized for the richness of their color, will not take on as deep a coloring as in the arid regions where the light is more intense. Yet the horticultural interests are rapidly developing and are proving to be very profitable.

In the "Sand Hill Region," where it was formerly supposed crops could not be grown, peaches, grapes and small fruits have been grown to a high state of perfection. Here large quantities of peanuts are grown, and besides yielding profitable crops are of value to the soil as nitrogen gatherers.

Apples

The commercial apple growing is principally in the hill and mountain region. The rich mountain soil, the cool climate, and protection from winds as well as the

air drainage, makes it a favorable location for the growing of apples in commercial quantities, and many large orchards are being planted each year. With the revival of the fruit industry in the state it has been shown that many steep and rough pasture lands that were formerly considered of little value, are well adapted to the growing of apples. Until the planting of these lands to orchard, they were gradually being devastated by the action of the winds, rains and atmospheric erosion, so that they were annually depreciating in value. Now, since the planting of trees, the soil is held by the roots of the trees, and it is considered that a tree grows into value at the rate of about $1 per year. It is easy to count from this that if 40 trees are planted on one acre it will grow into value at the rate of $40 per annum.

There is considerable difference of opinion as to the varieties best adapted to North Carolina conditions. Professor W. N. Hutt thinks that the Albemarle Pippin, Arkansas Black Twig, Bonum, Buckingham, Rome Beauty, Stayman Winesap and York Imperial are best.

Peaches

Peaches are successfully grown in any part of the state, but the largest commercial orchards are in the Sand Hill section in Moore and Montgomery counties. There is one orchard near Southern Pines in Moore county that contains 53,000 trees, and one in Montgomery county near Candor that is about the same in area. Besides, there are many orchards of smaller size, which make peach growing one of the important horticultural industries of the state.

Pears

Pears are grown in all parts of the state, but in the lowlands they are very susceptible to blight, which fact makes it unprofitable to grow them for commercial purposes. They can be grown successfully, for commercial purposes, in the clay soils of the Piedmont region. Here, the Kieffers are the most profitable and find a ready market on account of the quality of the fruit.

Plums

Plums can be grown successfully in all parts of the state, but are not grown extensively, because the peach brings larger profits in proportion to the cost of production.

Grapes

Grapes are not very choice of location, but succeed where almost any other varieties of fruits will grow. In this climate it is necessary to spray them well, in order to protect them from fungous diseases. They are especially susceptible to *phylloxera*. The Scuppernong grape is an exception to this; being a native of North Carolina, at least so it is claimed, it is the only variety that stands the ravages of this disease. It is claimed that the Rotundifolia type of grapes, of which the Scuppernong and James are the most common varieties, is native to the sandy soils of the Coastal Plain region. "These grapes are practically free from insect and fungous parasites, and produce enormous quantities of fruit, with the most indifferent tillage."

Strawberries

The strawberry is very adaptable, and will grow under very many conditions, yet there are places where the soil and climate seem specially adapted to the production of the best grades. One of these places is Columbus county. Here, during the whole season, train loads of iced cars of strawberries go out every day to the markets of the Atlantic coast cities. Here they ripen early, are especially bright and firm, and command good prices. From Chadbourn, in Columbus county, it is said that more strawberries are shipped in a single season than from any other strawberry shipping point in the world. The whole route of the Coast Line railroad is dotted with strawberry shipping points where the soil and climatic conditions are similar to those that have made Chadbourn famous.

On these soils dewberries are very successfully and profitably grown and bring good prices because they supply the demands of the early markets.

Pecans

It was not until recently that the value of the pecan and its adaptability to the coastal region were discovered. This variety of nuts had been growing wild from time immemorial, but they were not thought of as a great commercial crop. Recently, however, the nut has been so improved and the demand so increased that its growth for commercial purposes is very profitable. North Carolina has her share of the great Coastal Plains region and deep rich soil where the drainage is good, and the trees root deeply and find a climate suited to their demands.

Cranberries grow wild in the high valley lands of Watauga and Ashe counties, 3,500 to 4,000 feet above the level of the sea.

GRANVILLE LOWTHER

Frost and Precipitation in North Carolina

Station	Frost				Precipitation
	Average Date of		Date of		Annual inches
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	
Mount Airy	Oct. 16	Apr. 16	Oct. 1	May 8	46.3
Roxboro	Oct. 24	Apr. 10	Oct. 1	Apr. 24	46.6
Henderson	Oct. 31	Apr. 7	Oct. 10	Apr. 21	50.2
Weldon	Oct. 29	Apr. 9	Oct. 10	May 6	46.0
Linville	Sept. 30	Apr. 30	Sept. 14	May 27	60.2
Lenois Mount	Oct. 21	Apr. 17	Oct. 1	May 7	52.0
Soapstone	Oct. 17	Apr. 17	Oct. 1	May 6	50.3
Chapel Hill	Oct. 30	Apr. 8	Oct. 1	May 6	47.6
Raleigh	Nov. 3	Apr. 3	Oct. 8	May 6	49.9
Tarboro	Oct. 28	Apr. 11	Oct. 10	Apr. 30	51.7
Waynesville	Oct. 10	Apr. 20	Sept. 28	May 14	47.7
Asheville	Oct. 20	Apr. 22	Oct. 1	May 14	42.6
Highlands	Oct. 7	May 5	Sept. 17	May 26	78.2
Charlotte	Nov. 4	Apr. 1	Oct. 8	Apr. 26	49.6
Rockingham	Nov. 2	Apr. 10	Oct. 2	Apr. 24	50.6
Fayetteville	Nov. 8	Apr. 3	Oct. 19	Apr. 21	56.0
Goldsboro	Nov. 4	Apr. 4	Oct. 17	Apr. 21	51.7
Newbern	Nov. 8	Apr. 1	Oct. 10	Apr. 11	55.0
Hatteras	Dec. 11	Feb. 28	Nov. 7	Apr. 19	62.5
Sloan	Nov. 6	Apr. 4	Oct. 10	Apr. 21	54.4
Lumberton	Nov. 2	Apr. 4	Oct. 10	Apr. 28	51.0
Wilmington	Nov. 5	Mar. 27	Oct. 16	May 1	51.5
Southport	Nov. 16	Mar. 28	Nov. 7	Apr. 10	49.1

Production of Fruits in North Carolina

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	....	6,701	6,837	12,827,427	$853,076
Strawberries	5,668	5,420	5,616	10,313,361	712,126
Blackberries and dewberries	2,655	1,233	1,073	2,464,065	136,609
Raspberries and loganberries	331	40	69	37,764	3,388
Currants	89	3	28	5,382	400
Gooseberries	127	5	25	5,831	536
Cranberries	5	(1)	....	1,024	17
Other berries	....		26	....	....

[1] Reported in small fractions.

Strawberries are by far the most important of the small fruits raised in North Carolina, with blackberries and dewberries ranking next. The total acreage of small fruits in 1909 was 6,701 and in 1899, 6,837, a decrease of 2 per cent. The production in 1909 was 12,827,000 quarts, as compared with 11,934,000 quarts in 1899, and the value was $853,000 in 1909, as compared with $600,000 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total		8,162,464	..	2,971,879	6,324,301	$3,248,036	5,124,959
Apples	159,883	4,910,171	68,268	1,835,337	4,775,693	2,014,670	4,662,751
Peaches and nectarines	110,106	2,661,791	45,367	861,042	1,344,410	1,041,767	373,663
Pears	45,093	243,367	30,630	150,368	84,019	81,347	25,521
Plums and prunes	25,055	168,883	8,987	45,503	61,406	45,274	22,074
Cherries	28,568	168,065	11,608	74,111	53,788	60,453	33,899
Apricots	1,144	2,614	723	1,531	425	443	245
Quinces	3,603	5,738	1,494	3,439	1,125	1,017	(2)
Mulberries	77	1,835	42	548	3,435	3,065	(2)
Unclassified					....	....	[3] 6,806
Grapes	43,121	411,278	14,490	120,208	15,116,920	336,083	12,344,001
Nuts, total	.	[4] 29,462	......	[4] 32,737	[4] 1,244,629	[4] 28,535	244,330
Persian or English walnuts	563	2,125	509	1,731	73,303	3,686	180
Pecans	1,117	6,876	2,110	20,781	74,861	8,194	10,900
Black walnuts	3,929	19,570	1,666	9,180	1,081,480	16,138	(2)
Unclassified			..	.	...	.	[3] 233,250
Tropical Fruits, total		[5] 21,227	....	[5] 7,922	....	[5] 22,771	....
Figs	7,159	21,054	2,296	7,783	660,624	22,632	14,510

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes almonds butternuts, chestnuts, Japanese chestnuts, chinquapins, hickory nuts, Chinese walnuts, Japanese walnuts, filberts, hazelnuts and other nuts.
[5] Includes oranges, lemons Japanese persimmons and pomegranates.

The total quantity of orchard fruits produced in 1909 was 6,324,000 bushels, valued at $3,248,000. Apples contributed about three-fourths of this quantity; peaches and nectarines most of the remainder. The production of grapes in 1909 amounted to 15,117,000 pounds, valued at $336,000, and that of nuts to 1,245,000 pounds, valued at $29,000; the production of tropical fruits, mostly figs, was valued at $23,000.

The production of all orchard fruits together in 1909 was 23.4 per cent more in quantity than that in 1899, and the production of grapes also increased. The value of orchard fruits increased from $1,270,000 in 1899 to $3,248,000 in 1909, and that of grapes from $197,000 in 1899 to $336,000 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule:

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	8,240	3.2	Gals	647,152	241,006
Vinegar	9,056	3.6	Gals	188,610	103,887
Wine and grape juice	5,961	2.3	Gals	205,152	146,699
Dried fruits	15,569	6.1	Lbs	1,500,681	2,744,450

North Dakota

North Dakota lies in the great plains and prairie district of the north central states. It is subdivided into three sections of prairie tableland. The first is the valley of the Red river, along the eastern edge of the state, with an elevation of about 798 feet at Pembina to 965 feet at Wahpeton, in the extreme southeast. To the west of this plain lies another, ranging in height from 1,200 to 1,600 feet and about 75 miles in width. West of this lies the highest plain, called the Coteau du Missouri. This division occupies about one-half the state and reaches an elevation of 2,700 feet.

Most of the state has been subject to glacial action and afterwards covered by the mud of the lakes, the largest of which was Lake Agassiz, which is said to have originally been larger than the present surface of all the Great Lakes combined.

The Red River valley is almost completely level and the soil is alluvial and lacustrine. Further west the surface is rolling or ridged, attaining gradually to the higher elevations, where the surface is more or less broken. The prevailing soils are sands, sandy loams, gravel and gravelly loams. In the western part are the so-called "Bad Lands," carved into fantastic forms by the winds, water and the drifting sands.

There is very little fruit grown in the state. The total number of bearing apple trees is reported to be 15,941; plums and prunes, 19,147; peaches are scarcely grown at all, and small fruits are not grown to any considerable extent. The counties producing the most fruits are Cass, with 1,426 bearing trees; Eddy, 1,163; Richland, 2,806; Sargent, 1,290; Traill, 1,371; Walsh, 1,318.

These counties are all in the eastern part of the state, and while it is true that with proper selection and adaptation, fruit growing might be much more largely developed, yet it seems to the inhabitants better to grow that to which their soil is specially adapted, and to buy their fruits, than to undertake to grow fruits largely under existing difficulties.

Irrigation is practiced in North Dakota in the northwest in the drainage basins of the Missouri and Yellowstone rivers, and in the southeast by artesian wells.

Granville Lowther

For additional information on orchard sites and soils, see *Selection of Site*, under *Apple Orchard.*

Frost and Precipitation in North Dakota

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Williston	Sept. 14	May 18	Aug. 18	June 10	15.6
Willow City	Aug. 31	June 1	July 30	June 14	15.4
Churches Ferry	Sept. 16	June 1	Aug. 27	June 14	18.
Milton	Sept. 12	May 29	Sept. 3	June 14	20.
Oakdale	Sept. 15	May 2	Oct. 10	June 6	17.
University	Sept. 14	May 14	Sept. 8	June 7	20.
Dickinson	Sept. 20	May 22	Sept. 10	May 26	14.
Bismarck	Sept. 15	May 15	Aug. 17	June 23	18.8
Jamestown	Sept. 14	May 26	Sept. 4	June 7	19.8
Ashley	Sept. 8	May 30	Aug. 29	June 7	17.6
Berlin	Sept. 12	June 2	Aug. 31	June 21	20.8
Wahpeton	Sept. 15	May 8	Sept. 7	June 9	21.3

Production of Fruits in North Dakota

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	......	399	67	285,696	$39,641
Strawberries	883	88	3	66,028	10,445
Blackberries and dewberries	75	2	1	3,404	470
Raspberries and loganberries	923	85	12	60,742	9,141
Currants	2,378	138	36	97,598	12,128
Gooseberries	1,857	86	10	56,804	7,332
Cranberries	29	[2]	[3]	1,120	125
Other berries		..	5	....	....

[1] It is probable that some of the potatoes and sweet potatoes and yams raised in farm gardens were not reported separately by farmers, but were included in their returns for vegetables.

[2] Reported in small fractions.

[3] Less than 1 acre.

The production of small fruits in North Dakota in 1909 was 285,696 quarts, as compared with 70,152 quarts in 1899, and the value $39,641, as compared with $7,785. Currants were the most important of the small fruits raised in the state.

Orchard fruits, grapes and nuts: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	....	40,296	....	128,037	5,685	$9,688	1,647
Apples	1,248	15,941	3,906	70,023	4,374	7,270	1,273
Peaches and nectarines	14	90	54	604	35	71	....
Pears	5	24	61	327	8	15	1
Plums and prunes	737	19,147	2,320	35,459	1,048	1,866	365
Cherries	410	5,076	1,837	21,484	209	445	4
Apricots	2	11	17	87	10	20	....
Quinces	2	7	4	22	1	1	(2)
Mulberries	....	....	2	31	....	....	(2)
Unclassified	....	....	....	....	....	....	[3] 4
Grapes	20	379	98	1,464	360	14	1,500
Nuts [4]	....	62	....	560	....	....	200

[1] Expressed in bushels for orchard fruits and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes pecans, chestnuts, butternuts, black walnuts, and hazelnuts for 1909 and miscellaneous nuts for 1899.

The total quantity of orchard fruits produced in 1909 was 5,685 bushels, valued at $9,688, while that of grapes and of nuts was entirely insignificant.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	....	....	Gals.	....	158
Vinegar	2	(1)	Gals.	44	126
Wine and grape juice	11	(1)	Gals.	128	99
Dried fruits	2	(1)	Lbs.	106	....

[1] Less than one-tenth of 1 per cent.

Northern Spy Apple for Massachusetts. See *Massachusetts.*

Northwestern Fruit Exchange Grading Rules. See under *Apple Packing.*

Northwestern Soils, Needs of. See *Apple Orchard Cover Crops.*

Nursery Stock, Inspection, Certification and Transportation of. See under *Law.*

Nursery Stock Selecting. See *Apple Nursery.*

Nutmeg

Myristica fragrans

Nutmegs are grown in the East Indies, West Indies, Brazil and Spice islands. They grow best in a rich soil in the valleys protected from the cold winds. The tree grows to a height of about 25 feet and bears a yellow pear-shaped fruit, which splits in half, exposing a single kernel surrounded by a false aril which forms the mace of commerce. The fleshy halves of the fruit are used as preserves in the countries where the trees are cultivated, and the mace is one of the most important spices of commerce.

The kernel with the aril is dried for several weeks. Then the aril is pounded off, leaving the kernel or nutmeg, which is then dusted with lime and sent to market. The poorer nutmegs are sorted out and a heavy oil, called oil of mace, is expressed from them.

Granville Lowther

Nut Growing

Nut growing in America has been reduced to a commercial basis only within the last few years. The pioneers of our Eastern states could find nuts anywhere —chestnuts, walnuts, hickorynuts, hazelnuts, pecans, beechnuts and acorns. On beechnuts and acorns they fattened their hogs, and gathered hickorynuts, walnuts and other varieties of nuts for winter use. Now that these forests are destroyed and their crops of nuts have gone with them, we are not producing these articles of food in proportion to the demand, and the amounts that we consume are mostly shipped from Europe, from whence comes more than 75 per cent of our supply.

The fact that nuts grew wild in abundance all over this country is evidence that the climate and soil are well adapted to them, as well adapted as any of the parts of Europe where they are such profitable crops. The only question seems to be, "Will it pay?" This is the ever-present question in the American mind, one that should be clearly worked out and intelligently met.

Nut trees will pay because of the fruit they will produce that can be put into the market and sold at profitable prices, because in future years the timber may become valuable, and because if planted on the hills they save the land from barrenness and prevent the soil from washing. This opens the whole question of reforesting our denuded lands that were once covered with an abundant growth of valuable timber; a question that has been discussed so much during recent years that it is scarcely necessary to enter into it here. I have known walnut groves planted in Illinois, Iowa, and in other places in the Mississippi valley two generations ago that have become immensely valuable. One farm of 160 acres in Iowa was all planted to walnut trees and sold for a price many times greater than the value of the land without the trees, because the walnut lumber could be worked into furniture.

Most people in considering the growing of nuts have only the crop in mind, with its commercial value. They do not consider the value of the timber, because that belongs to another generation. They do not consider the conservation of the soil of the hillsides, for that also is in the future. It is hard for some persons to see anything that is so far distant that they may not in the near future reap profitable results from it. This is why so many farmers give so little attention to orcharding. In fact, it is why so many are wage workers instead of farmers. They do not want to plant the seed and wait six months for the harvest. They want a job and a pay check coming in every month or perhaps oftener. However, there are those who can sow and wait for the coming crop, plant orchards and wait for them to grow, plant forests and permit their children or grandchildren to inherit them, rather than to allow them to inherit bare rocks and yellow clay.

Where Nut Trees Should Be Planted

Nut trees will grow almost anywhere from the rich alluvial soil of the bottoms to the heavy clay of the hill tops. However, we would advise planting them, generally, on the rough hillsides where, because of the difficulty of cultivation, corn, wheat, oats and potatoes cannot be easily grown. On the steep hillsides it is not practical to grow apples, peaches, pears, and other fruits on account of the difficulty of spraying, picking and cultivating. It is easy to see a contrast between the picking of fruits that are tender and have to be handled with extreme care, and hauled to the packing tables in baskets on sleds, as compared with the gathering of nuts that do not bruise in picking and which require no care in handling. We would therefore plant nuts on these rougher hillsides, not because they will not grow under other conditions on flat lands, or lands that can be cultivated, but because these lands will produce other crops that are difficult to handle, that require tender care, and can not be well produced on the rougher lands where nuts will grow.

For instance, take the farm where the writer was born in West Virginia. When

we left that country for Illinois in 1865 the hilltops were covered with chestnuts and hickory nuts, and the hillsides were covered with butternuts, black walnuts and hickory nuts. After forty years I returned and visited the place, and to my surprise there was not a tree standing that was there when we left, and scarcely a tree of any kind. The soil had been carried away by the action of the elements and left the bare rocks and the heavy clay on which nothing of value would grow. Now, the question is, whether it would not have been better for the one who bought it to have left those nut trees, planted others of improved varieties and handed down to his children after forty years one hundred acres of bearing nut trees, than to have given them an inheritance of bare hills, mostly rocks and an impoverished soil. I am persuaded that two acres of chestnuts and pecans on that farm would have yielded more money than the one hundred acres now yield, and my contention is that if nut trees were planted on the rough hillsides that cannot be utilized for ordinary field crops, and cannot be profitably planted to fruit on account of the difficulty of cultivating, spraying and picking, that these lands, now of no commercial value, could be made sources of profit, that they would grow better instead of poorer for the future generations, and that if this course were generally followed America would be immensely wealthier than it now is, because she would add to her commercial products something for which we pay annually millions of dollars to European growers.

While it is true that nut trees will grow and bring profitable returns on lands that are difficult to cultivate to other crops, it is equally true that they are sensitive to good soil and good treatment, and will yield better returns where the conditions are favorable, and the best soils will produce the best results.

In the growing of pecans it is especially true that a rich deep soil should be selected in which the roots may penetrate deeply. Walnuts incline more to put out strong lateral roots and will succeed on a shallower soil, while chestnuts will thrive on upland clay.

GRANVILLE LOWTHER

*Composition of Nuts and Their Uses as Food

The constantly increasing consumption of nuts throughout the United States augurs well for a better appreciation of their food value. The time when nuts were considered merely as a luxury, or as something to be eaten out of hand at odd times, is rapidly passing away. In earlier days the native hickories, butternuts, walnuts, chestnuts, pecans and many other nuts found in the United States were to be had in country regions for the gathering and were of no commercial importance. On the other hand, the English walnuts (to give them their most common name), almonds, cocoanuts, etc., brought from other countries, were relatively expensive luxuries.

Some nuts, like the native hazelnut and beechnut, still have practically no commercial value and, though palatable, are almost never offered for sale, doubtless because they are so small and difficult to gather in quantity. The chinquapin, a small nut allied to the chestnut, finds a limited sale in Southern cities, but is doubtless seldom if ever seen in other markets. In general, however, conditions have changed and our principal native nuts are now staple market commodities and bring good prices. At the same time, owing to changes in market conditions, and to the growing of foreign nuts in quantity in this country, the price of the imported nuts has dropped so that they are well within the reach of the majority.

From available statistics it appears that in 1910 the total quantity of almonds, cocoanuts, Brazil nuts, filberts, peanuts, walnuts and other nuts, shelled and unshelled, imported into the United States was, in round numbers, **115,093,000 pounds, with a value of $13,291,667. In 1910 the total almond crop in California reached 6,692,000 pounds and the

* U. S. Department of Agriculture Farmers' Bulletin 332

** Approximate.—Ed.

walnut crop 21,432,000 pounds. The richest yield of peanuts was reported from the Southern states, chiefly Virginia, Georgia and Tennessee, and amounted to 19,451,000 bushels for the United States.

The total quantity of home-grown nuts, including both native and introduced varieties, must far exceed the quantities imported, but in the nature of the case no estimates of the total quantities gathered and eaten are procurable. When we consider the constantly increasing demand for nuts and the large quantity which we import from other countries, the possibilities of the industry for the American nut grower are obvious. As the use of nuts has increased, many persons have turned their attention to the growing of native and foreign nuts on a commercial scale. This work has been forwarded by the Department of Agriculture, through the Bureau of Plant Industry, and by the California, Florida, Michigan and other agricultural experiment stations. With nuts, as with other crops, it has been found that, by selection and breeding, improved varieties are obtainable, of larger size, better flavor, thinner shells, or other desirable characteristics.

The increased demand for nuts is due in the main to two causes, namely, a better appreciation of their appetizing qualities and the numerous ways in which they form a palatable addition to the diet of the average family; and, secondly, to their use by the vegetarians and persons of similar belief—a group small in proportion to the total population, but still fairly large numerically—who use nuts, and more particularly the peanut, as a substitute for meat and other nitrogenous and fatty foods.

Even a cursory examination of the journals devoted to cookery and other branches of home economics and of the various books which are published on the subject will show the fairly general use of nuts for making soups, for stuffing poultry, for nut butters, nut salads, cakes, salted nuts and other dishes, and indeed several volumes devoted exclusively to nut cookery have been published.

Many special nut foods, such as malted nuts, meat substitutes, etc., have been devised and extensively advertised by the manufacturers for general use in the diet and for the special needs of vegetarians and fruitarians. It is said that some of these American nut products contain soy beans, but apparently the peanut plays a very important part in their composition. In either case, since the peanut, like the soy bean, is a legume, these preparations might more properly be compared with the bean cheese and other soy-bean products, so much used in China, Japan and other Eastern countries, than with such nuts as the walnut, almond or cocoanut.

Description of Nuts

The term "nut" is not a definite one botanically speaking, but is applied indiscriminately to a variety of certain fruits or parts of fruits and implies a more or less hard, woody covering surrounding a meat or kernel. The most diverse plant groups contribute to our nut supply, many of the common nuts being the product of our beech, chestnut, walnut and other deciduous trees and bushes. Not a few of the nuts which are eaten in large quantities are obtained from pines and tropical palms, while others, like the peanut and pistache, or pistachio, are obtained from leguminous plants, being the fruit, respectively, of a vine-like plant and a small tree. Still another, the water chestnut, is supplied by a water plant.

Most of the native and foreign nuts which we find in our markets are too familiar to need description. Several, however, are not so generally known.

Pinenuts, which grow in the cones of a number of varieties of native and foreign pines, are now fairly common in our markets. The Indians have always known and appreciated them and have passed on their knowledge to the white race. Then, too, many immigrants who came to this country knew the pinenut, for it has long been much eaten in

Italy and other parts of Southern Europe where there are a number of nut-yielding pines. A variety of pinenuts is used in India by natives and Europeans sometimes pounded and mixed with honey and sometimes like other nuts as dessert. In this country the small, rather pointed pinenuts (pinon) which are most common are usually marketed shelled, but as they grow are covered with a more or less hard, woody shell. The pistache nut (now grown in California) has long been used and is prized by confectioners for its delicate flavor and attractive green color, yet it is by no means common. The nuts are small, not unlike a bean in size and shape, though more pointed, and before marketing are freed from the pods in which they grow. The individual nuts are covered with a gray or purplish skin, and are blanched before they are used.

The so-called lichi nut, which is really a dried fruit surrounded by a nut-like shell and not unlike a raisin in flavor, is a favorite in China and has become quite common in this country since its introduction by the Chinese. The ginkgo nut, the fruit of an ornamental tree quite widely grown in the United States and sometimes called the maidenhair tree from the shape of the leaves, and which fruits abundantly in some regions, is seldom eaten except by the Chinese, who gather it whenever possible. The small, roundish, oval, thin-shelled nut is surrounded by a very acrid, bad-smelling pulp, the whole fruit being not unlike a green Damson plum in size and appearance. In China, Korea and other parts of the Orient this nut is much used as a food, but, so far as can be learned, is always cooked in some way. Roasted like a peanut, it has a pleasant flavor. The ginkgo nuts are on sale in the Chinese shops in San Francisco and doubtless in other cities, and were studied at the California experiment station some years ago, together with a number of other typical Chinese food materials.

The water chestnut, or horn chestnut *(Trapa bispinosa)*, an aquatic plant, produces a seed or "nut" which somewhat resembles two curved horns united in one, the kernel of which is largely used as a food by the inhabitants of Asiatic countries. This so-called nut is also on sale in the United States, but chiefly in Chinese shops. Another water plant *(Eleocharis tuberosa)* is also known as the water chestnut, but in this case it is the corm or bulb that is eaten. It is not unlike a chestnut in shape, and has a tough, brown skin. This is grown in Asia, but is imported by the Chinese in this country. A pointed nut or seed somewhat like a pecan in appearance, the pit of the Chinese olive *(Canarium* sp.) is also on sale at Chinese shops in the United States. The kernels are oily but palatable, resembling the common American butternut *(Juglians cinerea)* in flavor. Closely related species of Canarium nuts are also imported to some extent for general trade, though they are by no means common.

The candle nut of the tropics is very oily, and after it has been stored for some time and is thoroughly dried is edible and by many considered palatable. If eaten too soon, however, the croton-oil-like body which it contains generally causes very serious illness. The chufa, nut grass, or earth almond is a small tuberous root of a sedge-like plant and may, perhaps, be classed more properly with the vegetables than with the nuts. It is not common, though eaten to some extent.

From time to time new nuts make their appearance on the market as some nut prized locally becomes known to the trade. A nut which seems to be growing in popularity, though still uncommon, is the Paradise nut of South America, which resembles a Brazil nut in appearance and flavor. Still less common is the South African cream nut, though it is sometimes shipped to this country. The choicest member of the Brazil-nut group is the true "butternut" of the tropics, which is very seldom found outside that region. Its flavor is very delicate and delicious, but it does not keep well; and even if it would bear shipment successfully, the available sup-

ply is at present very small. The cashew nut of tropical regions, which many consider one of the most delicious nuts grown, has long been known. The roasted nuts both salted and plain are on sale rather commonly by dealers in fruits and nuts and the demand for them is increasing. Cashew-nut candy is also sold in a limited way in the United States. This nut must be roasted before it is eaten, as when raw it has poisoning properties which are, however, readily destroyed by heat.

The Kingsland chestnut was almost unknown a few years ago, but is now being cultivated in California. It somewhat resembles a filbert in appearance and is not a true chestnut. The tabebuia *(Telfairia pedata)*, from Zanzibar, is a nut eaten roasted, which has been grown in a very limited way at the Porto Rico Agricultural Experiment Station, and is almost unknown except in the region where it is native. The so-called nuts are the seeds of a pumpkin-like fruit, and are oval, rather flat, and much larger than pumpkin seeds. The flavor is oily and fairly palatable. Should a demand arise it could be supplied by Porto Rican growers. The use of such a seed as a nut suggests the common use in Russia of the sunflower seed, which is rich in oil and not unlike some of the common nuts in composition. The raw sunflower seeds are eaten out of hand at all times and by all classes. In China watermelon seeds are eaten in the same way.

The Flavor of Nuts

The flavor of nuts is very largely dependent upon the oils which they contain, though in some there are also specific flavoring bodies. The nut oils readily become rancid, the very disagreeable flavor of spoiled nuts being due to this property. Some nuts (for instance, the chestnut) have a starchy flavor as well as a "nutty" taste. The small native nut is much more highly flavored than the large Italian or the Japanese chestnut. The almond possesses the cyanic-acid flavor, which is characteristic of peach pits, plum pits, etc., and this might be expected when it is remembered that the almond is the dried pit of an inedible fruit somewhat resembling the peach in appearance and closely related to it botanically. Most almonds are mild flavored. The so-called bitter almonds are, however, very strong, the cyanic-acid-yielding glucosid being present in considerable quantity. In raw peanuts there is a decided flavor resembling that of the closely related beans and peas, and to some persons this is not unpalatable. In the roasted peanut, which most of us prefer to the raw, the flavor is largely dependent upon the browned oils and starches or other carbohydrates.

Composition of Nuts

The composition of nuts and nut products has been studied at a number of the agricultural experiment stations, notably California, Maine and Iowa, and the following table summarizes the results of this work, the American data being supplemented in a number of cases by the results of European analyses. For purposes of comparison several other common food materials are also included.

Average Composition of Nuts and Nut Products

KIND OF WOOD	Refuse	Edible portion						
		Water	Protein	Fat	Carbohydrates		Ash	Fuel value per pound
					Sugar, starch, etc.	Crude fiber		
Nuts and nut products:	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Calories
Acorn, fresh	17.80	34.7	4.4	4.7	50.4	4.2	1.6	1,265
Almond	47.00	4.9	21.4	54.4	13.8	3.0	2.5	2,895
Beechnut	36.90	6.6	21.8	49.9	18.0		3.7	2,740
Brazil nut	49.35	4.7	17.4	65.0	5.7	3.9	3.3	3,120
Butternut	86.40	4.5	27.9	61.2	3.4		3.0	3,370
Candle nut	.....	5.9	21.4	61.7	4.9	2.8	3.3	3,020
Chestnut, fresh	15.70	43.4	6.4	6.0	41.3	1.5	1.4	1,140
Chestnut, dry	23.40	6.1	10.7	7.8	70.1	2.9	2.4	1,840
Horn chestnut or water chestnut	....	10.6	10.9	.7	73.8	1.4	2.6	1,540
Chufa (earth almond)	....	2.2	3.5	31.6	50.2	10.5	2.0	2,435
Cocoanut	34.66	13.0	6.6	56.2	13.7	8.9	1.6	2,805
Filbert	52.08	5.4	16.5	64.0	11.7		2.4	3,100
Ginkgo nut (seeds)	....	47.3	5.9	.8	43.1	.9	2.0	940
Hickory nut	62.20	3.7	15.4	67.4	11.4		2.1	3,345
Lichi nut	41.60	16.4	2.9	.8	78.0		1.9	1,510
Paradise nut	45.70	2.3	22.2	62.6	10.2		2.7	3,380
Peanut	27.04	7.4	29.8	43.5	14.7	2.4	2.2	2,610
Pecan	50.10	3.4	12.1	70.7	8.5	3.7	1.6	3,300
Pinenut, Pinon	40.6	3.4	14.6	61.9	17.3	...	2.8	3,205
Pinenut, Spanish or pignolia (shelled)	....	6.2	33.9	48.2	6.5	1.4	3.8	2,710
Pistachio	....	4.2	22.6	54.5	15.6		3.1	3,250
Walnut	58.80	3.4	18.2	60.7	13.7	2.3	1.7	3,075
Almond butter		2.2	21.7	61.5	11.6		3.0	3,340
Almond paste		24.2	13.1	23.9	29.4	7.8	1.6	1,900
Peanut butter		2.1	29.3	46.5	17.1		5.0	2,825
Malted nuts		2.6	23.7	27.6	43.9		2.2	2,600
Cocoanut candy		3.9	2.4	11.9	76.7	4.5	.6	2,000
Peanut candy		3.0	10.3	16.6	66.9	2.1	1.1	2,115
Chestnuts, preserved (marron glace), air dried		18.2	1.3	.5	79.7		.3	1,530
Walnuts, preserved in syrup, air dried		16.9	13.6	20.0	48.6		.9	2,780
Cocoanut milk		92.7	.4	1.5	4.6		.8	155
Cocoanut, desiccated		3.5	6.3	57.4	31.5		1.3	3,125
Peanut coffee made from entire kernel	....	5.1	27.9	50.1	12.3	2.4	2.2	2,805
Almond meal		8.5	50.6	15.6	16.0	2.9	6.4	.....
Commercial nut meal		3.0	29.0	51.7	12.1	2.0	2.2	.....
Chestnut flour		7.8	4.6	3.4	80.8		3.4	1,780
Cocoanut flour		14.4	20.6	2.1	45.9	10.1	6.9	1,480
Hazelnut meal		2.7	11.7	65.6	17.8		2.2	3,185
Almond diabetic biscuit **a**		5.3	29.0	8.8	54.3	.5	2.1	.....
Commercial meat substitute **b**		55.2	12.7	21.8	6.3	1.8	2.2	.....
Do **b**		62.2	22.6	9.2	3.6	.9	1.5	.....
Other foods for comparison:								
Meat, round steak	....	65.5	19.8	13.6	....	....	1.1	950
Cheese, cheddar	....	27.4	27.7	36.8	4.1	....	4.0	2,145
Eggs, boiled	11.20	65.0	12.4	10.7	....	....	.7	680
Wheat flour, high grade	....	12.0	11.4	1.0	74.8	.3	.5	1,650
White bread	....	35.3	9.2	1.3	52.6	.5	1.1	1,215
Beans, dried	....	12.6	22.5	1.8	55.2	4.4	3.5	1,605
Potatoes	20.00	78.3	2.2	.1	18.0	.4	1.0	385
Apples	25.00	84.6	.4	.5	13.0	1.2	.3	290
Raisins	10.00	14.6	2.6	3.3	73.6	2.5	3.4	1,605

a Contains some wheat gluten. **b** It is claimed that such goods are nut products.

Refuse, mostly shell, constitutes a considerable proportion of the nuts as purchased, varying greatly with the different kinds. With fresh chestnuts the proportion is nearly 16 per cent, dry chestnuts 23 per cent, peanuts 27 per cent, almonds 47 per cent, and butternuts 86 per cent.

The edible portion of nuts, with few exceptions, is very concentrated food, containing little water and much fat. In general, nuts are also rich in protein. Those ranking highest in this nutrient, the pignolia, a variety of pinenut imported from Spain, with 33.9 per cent, the peanut with 29.8 per cent, and the butternut with 27.9 per cent protein, surpass most ordinary animal or vegetable foods in this respect. The almond, beechnut, and pistachio, with 21.4 per cent, 21.8 per cent, and 22.6 per cent, respectively, compare favorably with dried legumes. The Brazil nut contains 17.4 per cent pro-

tein, the filbert 16.5 per cent, the walnut 18.2 per cent, the hickory nut 15.4 per cent, the pinenut 14.6 per cent, the pecan 12.1 per cent, and the dry chestnut but 10.7 per cent. The dry acorn, fresh chestnut and cocoanut, with 6.4, 6.4, and 6.6 per cent, respectively, are not as rich in protein as bread.

Of the nuts here included the richest in fat is the pecan, with an average of 70.7 per cent, but seven other varieties—the Brazil nut, butternut, candlenut, filbert, hickory nut, pinenut, and walnut—contain upward of 60 per cent. The almond, cocoanut, and pistachio yield between 50 and 60 per cent of this nutrient. The beechnut, peanut, and pignolia contain about 50 per cent. In other words, in 13 of the varieties of nuts appearing in the foregoing table, half or more of the edible portion is fat or oil.

Only a few of the commonly used nuts yield any notable amounts of total carbohydrate matter, the dry chestnut, with 73 per cent, rating highest. Beechnuts, pinenuts, and peanuts have about 18 per cent. The quantity of starch found is, with some exceptions, quite small, ranging from 3 per cent in the beechnut to 27 per cent in the chestnut.

Nuts are, comparatively speaking, well supplied with mineral matter, this constituent in the majority of nuts exceeding 2 per cent. The ash of the walnut, almond, etc., is rich in phosphoric acid, and in this regard compares favorably with that of cereals. It would appear from the data on the digestibility of nuts that the mineral matter is as well assimilated as that from other common foods.

It is a matter of observation that the nuts of any given species produced in different regions, and indeed those from different trees of any given region, vary decidedly in size, flavor, and composition, the hickory nuts, for instance, from one tree being much more oily than those from another in the same locality. Advantage is taken of such natural variations in selecting wild nuts for cultivation, notably in the case of pecans, where the range in size and quality is very noticeable.

Digestibility of Nuts

With the exception, perhaps, of certain rich pies and puddings, no food material has the reputation for indigestibility that has been accorded to nuts. Discomfort from them is certainly not uncommon, and when it occurs, it seems fair to say, is largely due to insufficient mastication and to the fact that nuts are often eaten when not needed, as after a hearty meal or late at night; though it is undoubtedly true that nut protein as ordinarily eaten is not so easily or so completely digested as meat protein. Very likely the concentration of nuts, with but 3 to 5 per cent water, as compared with meats containing from 50 to 70 per cent water, is a contributing cause. If careful consideration were given to this matter, and if attention were paid to the proper use of nuts and their correct place in the diet, there would be less unfavorable comment on their digestibility.

The results of investigations carried on with fruit and nut diets at the California Agricultural Experiment Station afford tentative conclusions regarding thoroughness of digestion which should be of value to those who wish to use nuts as a staple article of food rather than as an occasional article of diet. This work has comprised 15 dietary studies and about 100 digestion experiments with elderly men, young men, women and children, of whom some had been vegetarians for years, and some had even limited their diet almost exclusively to fruit and nuts; others had previously lived on the usual mixed diet. The average coefficients of digestibility reported for 28 experiments with two men and one woman on a fruit and nut diet were: Protein, 90 per cent; fat, 85 per cent; sugar, starch, etc., 96 per cent; crude fiber, 54 per cent; and ash, 68 per cent, with 86 per cent of the energy available. The corresponding figures for three experiments with the same subjects in which no fruit or nuts were used are: Protein, 94 per cent; fat, 92 per cent; sugar, starch, etc., 96 per cent; crude fiber, 49 per cent, with 88 per cent of the energy available. The latter coefficients agree very closely with those in the average

of nearly 500 experiments with different sorts of mixed diet, namely: Protein, 92 per cent; fat, 95 per cent; and carbohydrates, 97 per cent.

Nuts were the main source of protein for the fruitarians, and it will be noted that this constituent had practically the same coefficient of digestibility in the nut and fruit diet as in the other cases cited. The studies with fruitarians have all indicated that nut protein is fairly well assimilated; and that this is true with the average healthy person is well illustrated by an experiment with a university student, who, though entirely unaccustomed to such fare, gradually changed from an ordinary mixed diet to one of fruit and nuts, which he followed for a time without apparent loss of health or strength.

It is somewhat difficult to arrive at definite conclusions regarding the actual percentage of nut protein digested or assimilated. The experimental data obtained at the California station show a range of 75 to 82 per cent digestibile protein when fruit and nuts were eaten together, but the figure for nut protein is doubtless higher. These coefficients were in all probability influenced by the fruit protein, which has been found to be less digestible than the nut protein. The digestibility of protein in 28 experiments with mixed diets, to which were added fruit and nuts, averaged 90 per cent.

As fruits, with the exception of the avocado and olive, yield only a small amount of fat, the fat which is contained in a fruitarian diet must be very largely obtained from the nuts. The average coefficients of digestibility for this nutrient in 30 experiments with men on a diet of fruit and nuts was 86 per cent, and in 28 experiments just referred to it was 85 per cent. These figures are about 10 per cent lower than the average coefficient for digestibility of fats in the ordinary mixed diet. The digestibility of the carbohydrates in nuts, so far as the available data show, is about equal to that of the same ingredients in other foods.

So far as can be ascertained no experiments have been made on the ease or rapidity of digestion of nuts. In the absence of such data it is fair to assume that within reasonable limits the finer the state of subdivision of the food material the easier, the more rapid, and perhaps the more nearly complete will be the digestion or assimilation, presupposing, of course, that the nuts are not eaten in addition to a hearty meal. Too much stress can not be laid on the necessity of thorough mastication of nuts. This is emphasized by the results obtained with one of the subjects at the California station, a man at moderately active work, who ate largely of nuts but did not properly masticate his food. The coefficients of digestibility of the food were far lower than for other subjects who chewed their food thoroughly. The experiments with fruit and nut diets in general indicate that nut protein is as easily, even if not quite so completely, digested as protein from bread and milk.

The present discussion refers only to the nuts included in the studies at the California station, viz., the almond, Brazil nut, cocoanut, peanut, pecan, pignolia and walnut. It is believed that these are typical of the ordinary edible nuts, but further digestion experiments are much needed for the purpose of testing some other nuts.

As regards the work of other investigators, both Memmo* and Merrill† report digestion experiments with cooked chestnuts. Memmo's subject was a farm laborer, 53 years old, working eight hours a day. The experiment lasted four days. During the first two the food consisted exclusively of chestnut products. This was modified during the last two days by the addition of herring and cheese. In this experiment 75 per cent of the protein, 87 per cent of the fat, 97 per cent of the total carbohydrates, and 83 per cent of the ash were assimilated. The last figure is exceptionally high; the others correspond to those reported for the California experiments with men on a fruit and nut diet.

The subjects of Merrill's experiments

* Ann. Inst. Ig. Sper. Univ. Roma, n. s., 4 (1894), p. 263.

† Maine Station Bulletin 131, p. 146.

were two men aged 23 and 34 years, respectively. A mixed diet was used. Each subject consumed daily 300 grams of the cooked chestnut flour, which furnished about 20 per cent of the proteids, 50 per cent of the fat, nearly 50 per cent of the carbohydrates, and not far from 40 per cent of the total fuel value of the food. The average digestion coefficients obtained for chestnuts with the two subjects were protein, 56 per cent; fat, 63 per cent, and total carbohydrates 98 per cent, while 89 per cent of the energy was available. Memmo also studied a kind of acorn bread eaten in Italy, and found it was fairly well assimilated, though not very palatable. In experiments made by Saiki‡ at Yale University, chestnuts were added to the diet to obtain data regarding the raw chestnut starch, and it was found that it was comparatively indigestible. This would suggest that it is desirable to cook chestnuts rather than to use them raw.

From the foregoing it would appear that, while it is not possible to determine the exact digestion coefficients for all nuts, enough has been done to indicate their high nutritive value and to show that the human system can assimilate a very large proportion of the nutriment contained in nuts when they are rationally eaten.

Place of Nuts in the Diet

It has been shown by numerous investigations that nuts are rich in protein and fat and that these nutrients can be fairly well assimilated. Nuts being such a concentrated food, their proper place in the diet is a matter for more careful consideration than is the case with many of the ordinary food materials. It must not be forgotten that a certain bulkiness of the diet is conducive to its normal assimilation, and that too concentrated nutriment is often the cause of digestive disturbances. It might be expected, then, that nuts could be most advantageously used in connection with more bulky foods, such as fruits, vegetables, breads, crackers, etc Most rationally used, they should constitute an integral part of the menu rather than supplement an already abundant meal. Since nuts are so concentrated, eating a considerable quantity out of hand at odd times will mean an oversupply of food if a corresponding reduction is not made in the quantity of other foods eaten during the day. The distress sometimes experienced when nuts are eaten is undoubtedly often due to improper mastication or to overindulgence, since investigations made at the California station indicate clearly that considerable quantities of nuts properly eaten do not cause distress. There is a popular belief that a little salt with nuts prevents the digestive disturbance resulting from eating them. To most persons salt undoubtedly adds to the palatability of the nuts, but no investigations have been found on record which demonstrate any actual improvement in the digestibility of nuts due to salt.

Considering all kinds, nuts are perhaps more often eaten raw than cooked, though some sorts like the peanut, which is not generally considered palatable raw, and the cashew nut, which is poisonous until roasted, are quite generally cooked.

In this country the native chestnut is very commonly eaten raw, and the small native nuts have a distinct and characteristic flavor. The European chestnut, when raw, is lacking in flavor and so is almost universally cooked. The Japanese chestnut is much like the European in its characteristics.

The cocoanut and the almond are important ingredients of many sorts of cakes and confectionery, and often nuts are used in cooking in many ways.

Nuts may be readily used as staple articles of diet, as an ingredient in salads and in soups, as a stuffing for poultry, in the making of desserts and in many other ways. Wild turkey stuffed with pecan nuts is a dish popular with old Virginia cooks, just as goose stuffed with chestnuts is prized in Germany. Salted nuts and nuts crystallized in sugar are very common accompaniments of other foods. In general, the nuts rich in protein and fat should be used in combination with carbohydrate foods, as bread, fruit, green

‡ Jour. Biol. Chem., 2 (1906), p. 251.

vegetables, etc., while such nuts as the chestnut, which do not contain much protein or fat, but are rich in carbohydrates, may be properly combined with meats, milk and cream, eggs, and other foods containing protein and fat.

Since nuts are relished by most persons, are nutritious, and may be readily used by themselves and in various palatable combinations as an integral part of the diet, they have a legitimate place in the menu. Those who, for any reason, wish to live on vegetable foods and dairy products or any form of vegetarian or fruitarian diet will almost inevitably look to nuts, particularly such as the peanut, for a considerable portion of their total nutritive material. A fruit and nut diet may be arranged to furnish sufficient protein, mainly from nuts, to satisfy the requirements of the body, but the concensus of opinion of well-informed physiologists seems to be that such a diet is not generally advisable nor to be recommended for the majority of mankind in place of the more usual mixed diet. It should also be remembered that numerous experiments have shown that the protein from mixed diet has a higher coefficient of digestibility than nut protein, which indicates that the protein of nuts is the less economically utilized by the body. The argument which is so often advanced that primitive man lived on nuts and fruits exclusively and hence his descendants should do so is not generally accepted.

The comparatively high price of many of the edible nuts, particularly when shelled, and the difficulty of cracking some varieties—like pecans, black walnuts and hickory nuts—and extracting the kernels at home, greatly militate against the freer use of nuts in the household. The consumption of peanuts and English walnuts is perhaps increasing faster than that of some other nuts; but, whatever sort is selected, they should, as already noted, form a part of the diet and not supplement an already sufficient meal.

Nuts and Nut Products for Diabetics

Nuts and nut products are often recommended as foods for diabetics and others from whose diet starch and sugar are excluded, or at least materially reduced. On this subject the following statements are made by A. L. Winton,* in a report of studies made at the Connecticut State Experiment Station of the composition of diabetic foods, chiefly commercial products:

"Most of the nuts, including walnuts, Brazil nuts, almonds, and filberts, since they contain no starch and only small amounts of sugar and dextrin but are rich in protein and oil, are valuable additions to the diet of diabetics. Almond meal is used in the preparation of various biscuits and bread substitutes. The chestnut is a notable exception among nuts, in that it is rich in starch and poor in fat, the composition of the shelled nut being much the same as that of wheat flour; it is therefore entirely unsuited for the use of diabetics. * * *

"The peanut, * * * although very rich in oil, contains about 11 per cent of starch, sugar and dextrin, of which about half is starch."

Nut Butters and Nut Milk

Within the last few years so-called nut butters have been used in increasingly large amounts, and at least one variety, namely, peanut butter, is made and sold in ton lots. It has already been stated that in order to insure the best physiological results from the dietetic use of nuts they should be thoroughly ground up by the teeth and that, other things being equal, the digestion coefficient will vary directly with the fineness of division. The nut butters, made as they are from the finely ground nuts with or without the addition of some water, oil, and salt, have a homogeneous consistency not unlike true butter, and when properly made the material is so finely divided that even if it is not thoroughly chewed it will presumably offer much less resistence to the digestive juices than nuts hastily eaten. Nuts, and hence nut butters, are very rich in fat, which readily becomes rancid and unpalatable. This is doubtless one of the

* Connecticut State Station Report, 1906, p. 153.

reasons why nut butters are quite commonly marketed in jars, etc., containing small amounts which may be utilized in a short time. The nut butters are recommended by vegetarians as a substitute for butter in culinary processes and for use at the table. By persons who are not vegetarians they are commonly used for making sandwiches and in other ways for their agreeable flavor and for the pleasing variety which they give the diet.

Nut butter may be easily made at home. The nuts may be pounded in a mortar, but a mill for grinding them is much more convenient and may be readily procured, as there are a number of sorts on the market. The process of making nut butters has been frequently described in journals and cookery books. Either the raw or the roasted peanut may be used for making peanut butter, but the roasted nut is the more satisfactory. The kernels should be freed from chaff and reduced to a paste in the grinding mill. Freshly roasted nuts are necessary, as those which have stood for a day or so after roasting lose in crispness, do not grind well, and tend to clog the mill. Any sort of nut may be used, but experience has shown that it is more difficult to make butters from the almond or Brazil nut than from the peanut. Blanching these nuts requires considerably more time and labor than is needed to free the peanut from the skin which covers the kernel, and they are also more difficult to grind. Nut butters will keep well if sealed in glass or earthenware jars. Tin cans also may be used, but are not quite as desirable. As might be expected, nut butters do not differ materially in composition from the nuts from which they are ground.

The nut butters just mentioned are entirely different from cocoanut butter or from cocoa butter, which are expressed and purified fats. Cocoanut butter, which is sold under a variety of trade names, is made, it is said, by extracting and refining the fat from the sliced and dried cocoanut or copra. Its natural color is white, and it is solid at ordinary temperatures, resembling refined beef fat in appearance. It is used as a substitute for butter and in various culinary ways. Chocolate and cocoa, as is well known, are both products of the cocoa bean, the former being much richer in fat than the latter. The fat which is extracted in the manufacture of cocoa is called cocoa butter and is used as a culinary fat and for other purposes. It is an entirely different product from the cocoanut butter mentioned above.

The liquid in the cocoanut, often called cocoanut milk, is not at all the same as the nut milks often referred to in books devoted to nut cookery, which may be made by mixing nut butter of any given sort with water.

By pouring a pint of boiling water on a freshly grated cocoanut, allowing it to stand until cold and then straining it, a milky liquid is obtained which is also sometimes called cocoanut milk or cream and is used in cooking and other ways in regions where cocoanuts are grown. On standing, the fatty portion rises to the top as cream rises on milk. Cocoanut cream may be served with fruits and used in other ways. These cocoanut products and similar articles made from other nuts are used to some extent by the strict vegetarians who do not care to use cows' milk.

A similar nut milk or emulsion of nut fat made from Java almonds (a species of Canarium) is used in Java, apparently with considerable success, as an infant food.

Nut Pastes and Nut Preserves

Pastes which are used by confectioners for candy making and in other ways are made from nuts with the addition of sugar. Sometimes water and starch are added, but such admixtures are inferior to the nut and sugar pastes. The most common material of this sort is the almond paste which is manufactured in large quantities in the United States and is also imported. It is used for making cakes, candies, etc., the highly ornamented cakes called "marzipan," so popular with the Germans, being one of the very well known almond paste confections.

Macaroons are also well-known cakes

made from ground almonds or almond paste. Cocoanut is also used for the same sort of cakes.

Chestnuts preserved or candied in syrup and then dried, the marrons glace of the confectioners, are esteemed a delicacy and are eaten alone or are used in confectionery, etc. Thus prepared they are a common commercial article. Much less common are the English walnut meats preserved in syrup, which are manufactured in Europe and exported to this country in limited quantities. Preserved nuts which are similar to these are made in this country, particularly for the soda-water trade. Often maple syrup is used instead of ordinary syrup. Nut syrups, in which the ground nuts are incorporated with the syrup, are also well known for the same purpose, and are quite similar to the nut bisques or similar pudding sauces made at home. As the data in the table show, such nut preserves are rich in carbohydrates, owing to the added sugar. In Germany walnut meats and spice are often added to the plum butter which is made in such quantities in many homes. In the tropics, a thick, sweet preserve is made from cocoanut and sugar which is much liked locally, though those who are not familiar with it consider it very sweet and insipid. The Turks make several products from walnut meats and grape juice which are considered wholesome and palatable foods. In one of these the nuts are strung on a strong thread and dipped in thickened grape juice until well coated with it.

Nut Flours and Meals

Among nut products may be mentioned nut flours and meals. Some of these are used in large quantities and are made on a commercial scale, while others, perhaps owing to the trouble and expense incidental to manufacture, find only a limited use. In general, meals are made from the ordinary edible nuts by blanching, thoroughly drying, and grinding. By using a nut mill such meals may be ground at home. Almond meal has been on the market for a long time, being used as food for diabetics and for making cakes, etc., as well as in a number of technical ways.

Special mention should be made of chestnut flour, which is on sale in the United States and is used for most of the culinary purposes for which the fresh nut is recommended. In Italy it constitutes a considerable part of the diet, in some regions being extensively used for making a sort of bread or cake. One of the most complete studies of the dietetic use of chestnuts has been reported by Memmo. According to that author, the chestnut often serves almost as the exclusive food of the peasants of Tuscany for a considerable part of the year. The whole nuts are eaten in a variety of ways; for instance, boiled in water without hulling, hulled and boiled, or roasted. From the flour various cakes and other foods are made. Sometimes dough made from chestnut flour and water is spread between chestnut leaves and baked in an oven, and sometimes the dough is baked between hot stones. Chestnut fritters are also used, though less commonly than the bread, as the oil needed to fry them is comparatively expensive. A half pound or more of chestnut flour made into porridge for breakfast, chestnut cakes for dinner, and chestnut porridge or macaroni for supper, with a little fish or cheese, is a common day's ration. Ground acorns, made into a sort of bread with the addition of about 75 per cent of flour, is a common article of diet in several regions, notably Umbria and Tuscany, but the bread is black and heavy and not very palatable.

The early travelers and explorers make mention of the extended use of nuts by the American Indians, and the custom of using acorns as a staple food is still kept up. The method of preparing acorns followed by the Indians of Northern California have been described by P. E. Goddard* in a publication of the University of California, and by V. K. Chesnut,† formerly of the Department of Agriculture. Briefly speaking, the shelled nuts

* Univ. Cal. Pubs., Amer. Arch. and Ethnol., 1 (1903), No. 1, p. 27

† U. S. Dept. Agri., Div. Bot., Contrib. Nat Herbarium, 7 (1902), p. 333.

are split, dried and ground with a mortar and pestle. The sifted flour is placed in a hollow in the sand on a convenient river bank and leached to free it from the bitter principles present. From the leached meal a porridge or mush is made, which to the ordinary palate is much improved by the addition of salt.

These typical Indian foods, when well prepared, are relished by many persons who have tried them, and it seems not improbable that improved methods of removing the tannin and bitter principles present in most varieties of acorns might result in the utilization of the acorn crop, which is fairly large throughout most regions of the United States and is generally wasted.

According to Chesnut's investigations, the California buckeye or horse-chestnut is also used by the Indians as a food and is leached to free it from poisonous or objectionable matters in much the same way as the acorn. Many attempts have been made in Europe and elsewhere to treat the fruit of the common horse-chestnut in some way so that it might be made wholsome and palatable, for it undoubtedly contains an abundance of nutritive material, particularly starch; but none of these attempts has been really successful.

In many regions nuts are commonly added to ordinary bread dough, and such nut bread is a favorite and staple food. The use of partly extracted peanuts and other nut meals with wheat and rye flour for bread making should also be mentioned. Such breads have been used for patients with diabetes, but have never come into general use, perhaps because they are not very palatable, since the nuts become rancid so readily. In this connection the coarsely ground or shredded and dried cocoanut so common in our markets should be mentioned. Sugar is often added during the process of manufacture. Such prepared cocoanut is commonly used when it is not convenient to use the fresh nut. The cocoanut is much used in fancy cooking in the United States. In regions where it is grown it is a staple food. The pulp of the immature nut is considered a delicacy, and is used in many ways. When frozen and served as an ice it is said to be especially delicious. The meat of the ripe nut is used in the preparation of a great variety of dishes, including sweets as well as other foods, and the cocoanut milk, particularly that of the unripe nut, is a very common and wholesome beverage. The so-called "milk" is in reality water which the plant stores in the nut and is very pure, containing only a little mineral matter, sugar, etc., in solution. In addition to the fact that it is palatable and usually cool, it is a much safer beverage than water from some possibly contaminated spring or stream.

Nut Candies

One of the most extensive uses of nuts is in the manufacture of candy of various sorts, such as sugared almonds, burnt almonds, nut chocolates, caramels, penoche, nut brittle, etc. While there are some differences in the process of manufacture followed in these candies, they all in the main consist of nuts and sugar in varying proportions, with flavoring extracts, and in some instances butter and flour. Perhaps the best known nut candy the world over is nougat, which is of Oriental origin, and is a compound originally made of nuts and honey, but now more often of nuts and sugar. Usually almonds, filberts, pistachios, and pinenuts are employed in nougat making, but the kind of nut is necessarily very largely a matter of convenience. Sometimes burnt almonds are used instead of the blanched nuts. The nougat which our confectioners supply is soft in texture, but a brittle, hard sort is made in Europe and is imported to this country from Spain, the oblong blocks, about 6 by 4 by 2 inches, being wrapped in wafer and sealed in tins.

The table shows the composition of common sorts of nut candy. As may be seen, the water content is low and these candies are highly concentrated foods. On account of the added sugar the carbohydrate content is high. The proportion of nuts used in candies varies. By assuming that the nuts furnish the bulk of the fat in the candy it is estimated that nuts constituted about 50 per cent in the speci-

mens analyzed. It is perhaps well to suggest that nut candies and other candies which sometimes cause digestive disturbances would be more satisfactory if eaten in a rational way and at the proper time. Since they are concentrated foods they should naturally replace an equivalent amount of some other food material and not be eaten in quantity simply for their palatable flavor in addition to an otherwise adequate daily ration.

Nut Coffees

A number of coffee substitutes made from nuts have been devised and placed on the market, peanut coffee and acorn coffee being by far the most common. The nuts are parched and sometimes otherwise treated. Such coffee substitutes lack the stimulating properties of true coffee, and the infusion does not have the high nutritive value which is sometimes claimed for it.

Green Nuts

A number of kinds of nuts are used before they are fully ripe, and are esteemed a delicacy. In California in spring the markets quite commonly offer green almonds—that is, the almonds picked from the tree while the husk is of a decided green color and easily separated from the soft and immature shell. The kernel, after the skin is peeled off, is eaten with or without salt, and is relished by many persons. The price of green almonds in California markets commonly varies from about 20 to 35 cents per pound. Green almonds are found to a limited extent in fancy fruit shops in Eastern cities and elsewhere, and are perhaps purchased as much for their ornamental appearance as for their palatability. They are much more commonly used in Europe than in the United States. Green English walnuts and green hazelnuts are also eaten to a considerable extent in Europe and are great favorites. The nuts are gathered when the shells are fully matured but not thoroughly ripe. Sometimes these green nuts are imported into the United States. Many who have grown up in the country will recall the delicate flavor of the immature butternut and hickory nut and the stained fingers which they caused. Such green nuts have apparently never been marketed.

Whole green walnuts and some other nuts are also used in a quite immature state for pickle making. They are picked when still tender enough to be easily pierced by a large pin; then, after being kept in brine for a number of days, they are exposed to the sun until they turn black. Afterwards they are placed in jars and covered with hot vinegar and spices. Sometimes they are treated with dry salt instead of brine before pickling. It is claimed that nuts thus treated will blacken without being exposed to sunlight. Such pickled nuts are considered by many as a very palatable relish for use with meats and poultry. Walnut catsup is also made from green walnuts.

Nut Oils and Oil-Cake Meals

In some parts of Europe almond oil, walnut oil, and beechnut oil are manufactured and prized as salad oils, and in South America Brazil-nut oil is used for table purposes. Cocoanut oil is an important oil in the tropics. Peanut oil finds a large technical application and is also used in large quantities as a salad oil and for culinary purposes. Oils are also made from the kernel or nut of the peach and apricot, but these, like most nut oils except those mentioned, are used for medicinal or technical purposes rather than for food.

The various nut oils, which are practically pure fats, have a very high fuel value, and like olive oil and other oils, may constitute an important energy-yielding constituent of the diet. It is commonly assumed that, like olive oil, these oils are readily assimilated when properly combined with other food materials, as in salads, as "shortening" for various dishes, and in similar ways.

The oil-cake meals, as the ground products remaining after the expression of the nut oils are called, are much used as food for live stock and all kinds of poultry, and this is especially true of the peanut and cocoanut oil cakes. It has been suggested that such oil-cake meals might be valuable dietary articles if properly manipulated, as they of course contain a

higher percentage of protein than the original nut. Some attempts have been made to thus utilize peanut-cake meal, but the results have not been very satisfactory.

Pecuniary Economy of Nuts

The composition and digestibility of nuts have been discussed in the foregoing pages, but little has been said regarding the cost of nutrients and energy which they supply as compared with other and more common food materials. The table which follows shows the comparative cost of a pound of protein and 1,000 calories of energy when furnished by different nuts and nut products and some other staple foods, and also the amounts of nutrients and energy which 10 cents worth of these foods would supply, rating the foods at certain average prices per pound.

Pecuniary Economy of Nuts and Nut Products

KIND OF FOOD	Price per pound	Cost of one pound protein	Cost of 1,000 calories energy	Amount for 10 cents				
				Total weight of food material	Protein	Fat	Carbo-hydrates	Energy
Nuts and nut products	Cents	Dollars	Cents	Pounds	Pounds	Pounds	Pounds	Calories
Almonds	20	1 76	13 0	0.50	0.06	0.14	0.14	767
Brazil nuts	20	2.26	12.6	.50	.04	.16	.02	789
Chestnuts	8	1 48	8.3	1 25	.07	.06	.44	1,196
Cocoanuts	5	1 16	2.7	2.00	.08	.73	.29	3,662
Hickory nuts	9	1 55	7.1	1.11	.06	.28	.04	1,404
Peanuts	7	32	3 6	1.43	.31	.45	.20	2,767
Pecans	15	2 47	9.1	.67	.04	.23	.04	1,003
Pignolias	25	74	8.4	.40	.14	.20	.03	1,182
Pistachios	20	88	6 1	.50	.11	.27	.08	1,124
Walnuts	20	2 66	16 0	.50	.04	.13	.03	633
Almond paste	40	3.17	21 0	.25	.03	.06	.10	475
Peanut butter	20	.68	7.1	.56	.15	.23	.09	1,412
Peanut candy	25	2.42	11 8	.40	04	.07	.28	845
Other foods for comparison:								
Porterhouse steak	25	1.31	22 5	40	.07	.07	.	444
Whole milk	4	1.21	12 0	2 50	.08	.10	.13	815
Cheddar cheese	16	.58	7 5	.62	.17	.23	03	1,330
Wheat flour	3	.26	1.8	3.33	.38	.03	2 50	5,495
Beans, dried	5	.22	3 1	2 00	.45	.03	1 19	3,210
Potatoes	2	1.11	6 4	5 00	.09	. . .	.74	1,550

The common nuts—though, with the exception of the peanut, they are more expensive sources of protein and energy than meat and a number of the common foods—may yet be considered reasonably cheap sources of nutrients and energy, and hence may be regarded as justifiable additions to the diet on the score of economy. For the vegetarian or fruitarian, who looks to nuts as the chief source of protein in the diet, the peanut must be considered as much the most economical. As may be seen by a reference to the table, 10 cents will purchase more protein and energy when expended for the flours and meals than for any of the other foods, but it must be remembered in this connection that these are the raw materials requiring considerable preparation before they are palatable. This is not necessary with fruits and nuts, except in the case of the peanut and chestnut, which are usually roasted before they are considered palatable by most persons, though there are those who prefer them raw. When considering nuts, it is readily observed that 10 cents will buy about the same amount of nut protein as of animal protein, except in case of cheese and skim milk. If spent for peanuts, it will purchase more than twice the protein and six times the energy that could be bought for the same expenditure for porterhouse steak.

It is of more than passing interest to note that 10 cents' worth of peanuts will contain about 4 ounces (120 grams) of protein and 2,767 calories of energy,

which is more protein and energy than is furnished by many rations regarded as adequate for a day. Although peanuts supply protein and energy for a smaller sum than bread, they are outranked by dried beans, which, at 5 cents a pound, will supply for 10 cents over 200 grams of protein and 3,200 calories of energy. If more peanuts and dried beans were used by fruitarians, their diet would be enriched and the cost decreased. The almond, so much in favor with fruitarians, furnishes for 10 cents about one-fourth the protein and less than one-third the energy supplied by peanuts.

Handling and Marketing Nuts

Within the last few years the trade in shelled nuts has very markedly increased, and shelled walnuts, hickory nuts, almonds, English walnuts, pecans, etc., are now very commonly found in shops. The bulk of the nut crop is, however, marketed unshelled. Some of the unshelled nuts, notably pecans and peanuts, are very often polished before marketing by rotating them in rapidly revolving drums in such a way that the shells are worn down until they are more or less smooth. This method of treatment also removes any dirt and is supposed to make the nut more salable. It is worthy of note, however, that the highly prized, large fancy pecans are marketed without such treatment.

In cracking nuts, if one wishes to obtain the meats unbroken, it is necessary, as everyone knows, to hold the nut in such a position that the shell will be crushed along certain definite lines. Thus, hickory nuts must be struck on the thin side and pecan nuts and native butternuts or white walnuts on the end. With such nuts as the almond and filbert or cobnut less care is needed, as the nut is loosed inside the shell. There are a number of machines for cracking nuts on a wholesale scale for market purposes, which give a very large proportion of unbroken nut meats. In most of these the nuts passing from a hopper to some device like an endless chain with pockets for holding them in the right position are crushed one at a time by automatically moving plungers. The machines which are used naturally vary in principle and in details of construction, one which would be satisfactory for a peanut or soft-shelled almond being less well adapted for use with such nuts as hickory nuts or pecans. Some of the machines used for peanuts and almonds are equipped with devices for removing the skin or hull which covers the nut meat.

In order to meet the market demand for clean and uniformly colored nuts, many nut growers have resorted to the process of bleaching their product. The first attempts in this direction were made by sulphuring—that is, by exposing the nuts to sulphur vapor. This treatment, though improving the color of the shell, proved injurious to the flavor of the nuts and lessened the keeping qualities. At the California Agricultural Experiment Station experiments with bleaching solutions have been carried on and very satisfactory results have been obtained with a mixture of sal soda, chlorid of lime and water. According to reports of the Imperial Department of Agriculture of the West Indies,* a similar process has been successfully used for bleaching peanuts. The consumer should bear in mind that the bleaching of nuts is entirely unnecessary and in no way increases their food value. The process is carried on solely for the purpose of improving the appearance of the nut, and thus commanding a higher price. It will doubtless be continued as long as the public is willing to be guided by appearance rather than food value. The term "bleaching," as applied to nuts, must not be confounded with the household term "blanching," which applies to the process of removing the skins from nut meats, as almonds and pistachio nuts, by immersing them for a short time in hot water and then rubbing off the skin.

Vegetables and fruits exposed for sale under ordinary conditions may be readily contaminated with bacteria, dirt and dust. Nuts sold in their shells are protected in large measure from such con-

* Imp. Dept. Agr. West Indies Pamphlet No. 43, n. s.

tamination, yet many careful housewives wash, or at least wipe, the nuts which are to be cracked and served in the shells, as anything which adheres to the shell might readily contaminate the nuts after cracking, if all were mixed together in a dish.

Shelled nuts are now common commercial products. They are sometimes sold in tight packages, but more often are not thus protected from dust and insects, and should always be washed before they are used. Pouring hot water over nuts which are to be used for salad and other dishes is a practice which is recommended, as it removes any acrid taste and gives the nuts a fresh flavor and appearance.

If exposed to damp conditions, nuts mold and decay, and even under favorable conditions the nut oils and fats become rancid on long-continued storing. In the main, however, the keeping qualities of most nuts are excellent. Nuts, and particularly shelled nuts, should be stored in such a way that they may be free from attacks from insect enemies. When such precautions are not taken, "wormy" nuts are by no means uncommon.

Summary

Summarizing the foregoing data, it may be said that nuts are a very concentrated food, even more so than cheese, but when rationally used they are well assimilated and may form a part of a well-balanced diet. Nuts are a very valuable source of protein and fat, these two nutrients being the characteristic constituents of the more common nuts, of which the walnut and cocoanut may be taken as types. In nuts like the chestnut, carbohydrates are a characteristic constituent. For most families it is undoubtedly wiser to use nuts as part of the regular diet than as a condiment or supplement to an otherwise hearty meal.

Vegetarians and others who use nuts in place of meat should not depend upon them as the main food supply, but should supplement them with more bulky foods with a low content of protein and fat. As a whole, nuts may be classed among the staple foods and not simply as food accessories. At usual prices, nuts are reasonable sources of protein and energy. Peanuts supply protein and energy very cheaply, even compared with such staple foods as bread and beans. There are a number of nut foods on the market, but it may be stated that there is little to be gained from the standpoint of food value or economy in their use in place of the ordinary nuts and home-made nut products, especially by healthy persons who are willing to masticate their food thoroughly and to use nuts in reasonable combinations. Unless something has been added, the nutritive materials in such special preparations can not be greater than the nuts from which they are made, though in the mechanical condition or in some other way the foods may be better fitted for ready assimilation. Furthermore, nut butters and similar foods give a pleasant variety to the diet, and they are relished by many who would not care for the unprepared nuts.

Though less subject to contamination than many other foods, nuts should be handled and stored under good conditions, and especially should be protected from dampness and insect enemies.

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For Varieties of Nuts, follow the *Alphabetical Order*.

Nut Culture in Washington. See *Washington*.

Production of Nuts in the United States

Almonds, Pecans, and Persian or English Walnuts—Trees, Production, and Value

STATE	1910		1909		1899
	Trees of bearing age	Trees not of bearing age	Production (pounds)	Value	Production (pounds)
Almonds, total	1,187,962	389,575	6,793,539	$711,970	7,142,710
Arizona	6,639	845	33,759	4,193	116,510
California	1,166,730	365,961	6,692,513	700,304	6,992,610
All other states	14,593	22,769	67,267	7,473	33,590
Pecans, total	1,619,521	1,685,066	9,890,769	971,596	3,206,850
Alabama	44,683	125,734	228,341	30,540	60,670
Arkansas	13,958	13,811	249,955	17,603	86,050
Florida	42,512	176,207	307,632	43,962	46,800
Georgia	75,519	325,779	354,046	47,845	27,440
Illinois	28,330	8,223	107,069	10,301	41,380
Louisiana	36,527	119,547	723,578	70,635	637,470
Mississippi	60,524	148,030	637,293	79,936	242,300
Missouri	48,822	7,214	147,420	10,467	75,170
North Carolina	6,876	20,781	74,861	8,194	10,900
Oklahoma	96,766	53,796	894,172	59,481	[1] 16,580
South Carolina	33,366	43,639	159,823	20,442	13,020
Texas	1,087,619	621,550	5,832,367	556,203	1,810,670
All other states	44,019	20,755	174,212	15,987	138,400
Persian or English Walnuts, total	914,270	806,413	22,026,524	2,297,336	10,668,065
California	853,237	546,804	21,432,266	2,247,193	10,619,975
Mississippi	2,705	5,513	66,492	6,949	5,670
Oregon	9,526	177,004	79,060	8,288	6,110
All other states	48,802	77,092	448,706	34,906	36,310

[1] Includes Indian Territory.

Nuts—Production and Value by States

STATE	Production (pounds)[1]		Value [2]	
	1909	1899	1909	1899
Total	62,328,010	40,028,825	$4,447,674	$1,949,931
Alabama	439,382	193,570	37,986	6,315
Arizona	35,834	121,060	4,485	9,328
Arkansas	787,854	533,700	27,513	8,898
California	28,378,115	17,775,505	2,959,845	1,441,137
Connecticut	137,987	855,550	5,102	17,432
Florida	382,535	98,470	47,456	8,453
Georgia	845,553	181,710	61,106	3,997
Illinois	714,478	360,680	20,550	6,520
Indiana	439,644	588,800	7,344	6,254
Iowa	1,721,265	484,850	36,922	7,603
Kansas	402,714	310,830	7,625	6,097
Kentucky	946,428	403,270	17,231	8,365
Louisiana	796,925	665,770	73,169	51,457
Maryland	318,148	65,950	5,687	2,055
Massachusetts	134,920	462,800	3,671	12,106
Michigan	961,137	470,700	18,956	7,436
Mississippi	866,504	313,620	90,855	17,158
Missouri	2,823,368	1,747,520	39,746	19,838
Nebraska	384,325	93,000	8,906	1,595
New Hampshire	254,521	249,900	3,684	6,329
New Jersey	249,626	947,950	7,116	20,660
New York	2,773,858	3,451,550	74,420	71,122
North Carolina	1,244,629	244,330	28,535	3,413
Ohio	559,093	295,250	11,691	4,871
Oklahoma	1,019,238	[3] 45,330	62,168	[3] 1,034
Oregon	177,632	42,980	13,208	2,560
Pennsylvania	3,795,804	5,065,500	90,447	91,149
South Carolina	376,013	213,320	26,888	3,868
Tennessee	783,570	659,660	14,041	5,828
Texas	5,945,932	1,836,970	562,542	78,971
Virginia	841,572	376,440	22,161	5,109
West Virginia	974,312	502,900	16,049	4,488
Wisconsin	609,428	80,150	18,196	1,460
All other states	1,205,666	289,240	22,373	7,025

[1] Does not include cocoanuts, which are reported by number.
[2] Includes value of cocoanuts.
[3] Includes Indian Territory.

Nuts Grown in the United States

The number of bearing nut trees (all varieties) in the United States, according to the census of 1910, is as follows:

(Scale, 6 mm=1,000,000.)

California, 2,034,302.

Iowa, 1,721,265.

Texas, 1,104,360.

Pennsylvania, 175,457.

New York, 164,333.

Missouri, 153,244.

Kansas, 143,044.

Oklahoma, 96,766.

Georgia, 86,329.

Illinois, 85,428.

Nebraska, 79,090.

Mississippi, 66,727.

Virginia, 53,184.

Alabama, 51,585.

Florida, 43,998.

West Virginia, 42,147.

Wisconsin, 40,789.

South Carolina, 38,743.

Louisiana, 38,466.

Michigan, 37,297.

Tennessee, 24,926.

Vermont, 24,534.

New Jersey, 22,764.

Ohio, 21,702.

Kentucky, 21,339.

Indiana, 19,179.

South Dakota, 18,409.

Oregon, 16,902.

Arkansas, 13,958.

Maryland, 11,780.

New Hampshire, 10,188.

Connecticut, 9,248.

Minnesota, 8,110.

Washington, 7,107.

Arizona, 6,812.

Massachusetts, 6,720.

Colorado, 3,667.

Delaware, 1,962.

Utah, 1,737.

Idaho, 1,379.

Nevada, 972.

Maine, 815.

New Mexico, 503.

North Carolina, 84.

North Dakota, 62.

Rhode Island, 47.

Montana and Wyoming are not reported as growing nuts.

Imports of Nuts for the United States—Years Ending June 30, 1909-1910

ARTICLES	Pounds	Value
Nuts—		
Almonds:		
Not shelled (pounds)	6,810,055 60	$ 504,662.59
Clear, shelled (pounds)	10,495,750.00	4,402,124.99
Apricot and peach kernels (pounds)	27,853.50	5,230.00
Cocoanuts:		
In the shell	. . . .	1,298,969.97
Meat, broken, or copra, not shredded, desiccated or prepared (pounds)	20,830,539.00	762,560 00
Meat or copra, desiccated, shredded, cut, or similarly prepared (pounds)	5,985,308.00	384,972.00
Cream and Brazil (bushels)	461,496.00	1,251,738 00
Filberts:		
Not shelled	10,026,961.00	620,508.69
Shelled	1,413,391.00	170,450.00
Marrons, crude (pounds)	10,270,398.00	244,106.00
Olive nuts, ground	. . . .	478.00
Palm and palm-nut kernels	. . . .	6,907.00
Peanut, or ground beans:		
Unshelled (pounds)	11,297,172.00	419,184.59
Shelled (pounds)	16,089,919.00	729,382 00
Pecans (pounds)	3,349,460.00	232,590 00
Walnuts:		
Not shelled (pounds)	23,269,974.22	1,545,197.34
Shelled (pounds)	10,960,988.00	1,851,408.75
All other, shelled or unshelled, not specially provided for (pounds)	3,580,855.00	346,650.73
Do (from Philippine Islands)	3,689.00	75.00
Total nuts (free)	. . . .	$3,564,355 97
Total nuts (dutiable)	. . . .	9,210,839.68
Total fruits and nuts (free)	. . . .	$15,627,166.79
Total fruits and nuts (dutiable)	. . . .	21,229,071.68

Ohio

The state of Ohio has been divided, physically, into five parts, the central and western central portions, consisting of an elevated plateau which was formed by glaciers; the northern and northwestern portions, whose soil was formed of deposits of sand, gravel and clay washed from the glacial uplands into what was once a lake basin; the extreme southwest, which is thinly glaciated upland covered with a limited amount of fine, silty loess material; the northwestern portion, consisting of a border of the Appalachian plateau, gently rolling, undulating, sometimes breaking into hills, and slightly glaciated; all Southeastern Ohio, which is more or less hilly, and the soils of which are formed of the eroded rocks that underlie the surface. In the north, bordering on the lake, are numerous sandy ridges which mark the ancient beaches of glacial lakes.

For the most part the soils of Ohio are rich and productive, consisting in places of vegetable loam, in others muck, limestone, clay and sand.

The temperature is very similar to that of other portions of the United States in the same latitudes, ranging from the extremes of 98 degrees above zero in summer to 30 degrees below zero in winter.

The average rainfall is about 38 inches per annum, varying somewhat in different parts of the state.

All the fruits of the north temperate zone, such as apples, peaches, pears, cherries, grapes, strawberries, blackberries, etc., can be successfully grown. However, some of these are not grown for commercial purposes, but for home use or to supply a limited local demand. Apples, peaches and grapes are the principal commercial fruits.

In general the soils best adapted to apples are the alluvial deposits containing a mixture of limestone. Ohio, like many of the other old fruit-growing states, several years ago permitted her fruit industry to decline when the scale and other fruit pests became uncontrollable under the old methods and before new methods were adopted. The fruit was of poor quality, and many of the trees died. Now, under the guidance of the state colleges and experiment work, much is being done to rejuvenate the

old orchards and to encourage the adoption of new methods for the new ones. The industry is now reviving and many commercial orchards are being planted.

The sections of the state where most apples are grown are the lake region, the Ohio River region and along the smaller streams that empty into the Ohio, such as Muskingum, Scioto and Miami.

There are few peaches grown in the state for commercial purposes, except along the lake, the most profitable section being Catawba Island. The lake region is also the most profitable section for the growing of grapes, the counties of Ashtabula, Cuyahoga, Erie, Ottawa, Lucas and Loraine producing most of the grapes shipped out of the state.

Trucking is profitable in the muck and reclaimed swamp soils of Hardin, Huron, Medina, Wayne, Cuyahoga, Summit and Stark counties, and celery, cabbages, onions, tomatoes, etc., are shipped in considerable quantities.

GRANVILLE LOWTHER

Frost and Precipitation in Ohio

Station	Frost: Average Date of First Killing in Autumn	Frost: Average Date of Last in Spring	Frost: Date of First in Autumn	Frost: Date of Last in Spring	Precipitation: Annual inches
Wauseon	Sept. 25	May 12	Sept. 2	June 1	37.7
Toledo	Oct. 15	Apr. 24	Sept. 9	May 29	30.8
Sandusky	Oct. 26	Apr. 14	Oct. 8	May 2	34.7
Cleveland	Oct. 31	Apr. 16	Oct. 2	May 22	35.6
Hiram	Oct. 14	Apr. 28	Oct. 2	May 21	39.7
Ottawa	Oct. 2	Apr. 27	Sept. 14	May 22	33.2
Marion	Sept. 30	Apr. 27	Sept. 14	May 17	35.4
Bangorville	Sept. 1	May 4	Sept. 12	May 31	39.2
Canton	Sept. 4	Apr. 25	Sept. 15	May 21	39.1
Greenville	Sept. 13	Apr. 22	Sept. 24	May 17	36.6
North Lewisburg	Sept. 13	May 4	Sept. 6	May 29	39.7
Columbus	Oct. 16	Apr. 16	Sept. 21	May 17	37.2
Cambridge	Sept. 28	May 2	Sept. 14	May 26	38.5
New Alexandria	Oct. 8	Apr. 27	Sept. 27	May 25	40.9
Dayton	Oct. 9	Apr. 17	Sept. 19	May 5	36.6
McConnellsville	Oct. 10	Apr. 27	Sept. 27	May 22	40.7
Marietta	Oct. 21	Apr. 13	Sept. 28	May 22	42.1
Clarksville	Oct. 9	Apr. 11	Sept. 14	May 7	38.7
Coalton	Oct. 7	Apr. 12	Sept. 14	May 10	36.2
Cincinnati	Oct. 19	Apr. 11	Sept. 30	May 24	38.4
Portsmouth	Oct. 5	Apr. 24	Sept. 3	May 30	40.4

Production of Fruits in Ohio

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small fruits, total		11,591	21,121	15,721,023	$1,296,343
Strawberries	8,799	4,706	9,373	8,501,065	677,767
Blackberries and dewberries	4,207	2,425	3,397	2,465,407	195,294
Raspberries and loganberries	6,175	3,869	6,795	4,029,480	364,272
Currants	2,861	359	765	460,575	39,829
Gooseberries	2,208	226	539	255,840	18,404
Cranberries	25	3		4,256	352
Other berries	2	3	252	4,400	425

Strawberries are by far the most important of the small fruits grown in Ohio, with raspberries and loganberries and blackberries and dewberries ranking second and third respectively. The total acreage of small fruits in 1909 was 11,591 and in 1899, 21,121, a decrease of 45.1 per cent. The production in 1909 was 15,721,000 quarts, as compared with 33,736,000 quarts in 1899, and the value $1,296,000, as compared with $1,767,000.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total		14,933,813		5,603,742	6,711,208	$5,691,530	21,399,273
Apples	201,044	8,504,886	77,900	2,438,246	4,663,752	2,970,851	20,617,480
Peaches and nectarines	102,863	3,133,368	50,736	2,092,300	1,036,340	1,349,311	240,686
Pears	113,897	899,019	38,248	333,739	374,871	332,727	244,565
Plums and prunes	96,203	1,001,734	33,053	332,811	215,657	278,505	81,435
Cherries	117,806	1,144,271	38,696	342,328	338,644	657,406	192,954
Apricots	2,456	5,462	660	1,873	835	1,343	449
Quinces	55,668	245,040	12,891	62,413	81,101	101,369	(2)
Mulberries	11	33	5	32	8	18	(2)
Unclassified							[3] 21,704
Grapes	82,576	8,326,800	12,295	455,750	43,933,207	858,594	79,173,873
Nuts, total		[4] 21,702		[4] 4,868	[4] 559,093	[4] 11,691	295,250
Persian or English walnuts	71	599	30	220	2,461	154	
Pecans	21	81	19	308	1,010	70	
Black walnuts	945	8,693	166	3,399	354,135	4,645	(2)
Chestnuts	289	3,347	10	107	36,091	2,584	(2)
Butternuts	79	875	8	123	29,100	360	(2)
Hickory nuts	674	8,053	35	674	135,626	3,856	(2)
Unclassified							[3] 295,250
Tropical Fruits, total		[5] 126		33		[5] 46	
Figs	29	117	8	33	710	39	

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes Japanese walnuts, hazelnuts, American nuts and other nuts.
[5] Includes Japanese persimmons.

The total quantity of orchard fruits produced in 1909 was 6,711,000 bushels, valued at $5,692,000. Apples contributed about two-thirds of this quantity, peaches and nectarines most of the remainder. The production of grapes in 1909 amounted to 43,933,000 pounds, valued at $859,000, and that of nuts to 559,000 pounds, valued at $12,000.

The production of all orchard fruits together in 1909 was 68.6 per cent less than that in 1899, and the production of grapes also decreased decidedly. The total value of orchard fruits decreased from $6,141,000 in 1899 to $5,692,000 in 1909, and that of grapes from $993,000 in 1899 to $859,000 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

Oil Sprays

There is a growing opinion among orchardists that oil as a spray for scale, aphis and various insect and fungus pests, is better than lime-sulphur. We think that at the present time the question has not been sufficiently tested to justify the expression of an opinion here, but the fact that some careful orchardists prefer it, raises a strong presumption in favor of its merits. As these sprays are generally prepared they are made of crude petroleum. However, a new oil has been manufactured from the waste timber of the forests of the Pacific coast and out of it is being prepared a spray called the "Crest Spray," for which its manufacturers claim the following merits:

The chemical analysis shows tar and kindred products, naphthal, pyroligeneous acid, Douglas fir oil, phenols, creosote, turpentine, resin, sulphur and soda. It is non-poisonous and harmless to the operator, who can put his hand into the solution without any other effect than removing the dirt.

The Crest spray requires no boiling or preparation like lime-sulphur and other sprays. It is shipped in very concentrated form so that while its price, $1.25 per gallon in barrel lots, is higher than most sprays, yet when diluted with 50 parts of water to one of the spray for winter spraying and 75 to 100 for summer spraying, it is more economical than lime-sulphur. It does not require nearly so heavy a pressure on the spray-pump as lime-sulphur. Being composed of oils which have a great spreading power when applied to wood, it penetrates the bark of the tree and the cocoons of the insects much better than the lime-sulphur. This gives it a greater covering power, so that one gallon goes about as far as two of other sprays.

One farmer figured out his spraying bill like this:

Five barrels lime-sulphur spray, or 250 gallons diluted eight to one, makes 2,000 gallons. Five barrels at $10 and $1.50 freight each, cost $57.50.

One barrel Crest spray, 50 gallons diluted fifty to one, makes 2,500 gallons of spray, winter spraying, or 5,000 gallons, summer spraying. It costs $62.50 and $1.50 for freight, or $64.

Oklahoma

For the most part Oklahoma is an undulating plain with strips of timber along the streams.

The drainage system belongs to the Arkansas and Red rivers, with the Cimarron and Canadian as tributaries to the Arkansas and the Ouachita as the principal tributary of the Red river.

The Ozark mountain range extends southward from Missouri and Arkansas, entering the state at an elevation of 2,500 feet and sinking relatively near the center to the general level of the country at an elevation of 1,000 feet, but rising again in the western part of the state in the Wichita mountains, the highest point of which is 3,000 feet above the level of the sea.

The eastern part is heavily wooded and along the streams has a rich alluvial soil. There are in Oklahoma various types of soil, but the prevailing type is a deep, dark, red loam which in the east central portion of the state is made up of decomposed sandstone, but in the north central is made up of shales and decomposed limestone. Sometimes there are belts of red clay loam on the uplands north of the rivers, a deposit of black alluvium on the bottoms on either side of the rivers and a belt of red clay loam on the uplands south of the rivers.

In the western part there are deposits of alkali in such areas as to damage the soil in considerable degree, while they are said to have the largest deposits of gypsum and salt in the world. Coal, oil, gas and zinc are abundant in the eastern part.

The climate is mild, but changeable. The rainfall at Beaver, in the extreme northwest portion of the state, is 18.9 inches per annum and the mean annual temperature 57 degrees.

At Lehigh, in the southeast, the rainfall is 35.1 inches and the temperature

60 degrees. At Oklahoma City the mean annual temperature is 59 degrees and the extremes have ranged from 17 degrees below zero to 104 above.

Notwithstanding the abundance of rainfall the air is dry and the sun hot. In July and August they have occasionally what they call "hot winds," which damage the crops. With proper irrigation or by planting orchards and gardens on the north slope of the elevated lands there could be sufficient protection against the hot winds so that profitable commercial crops could be grown. Without irrigation the best location for an orchard is on a northern exposure, where it will not receive the direct rays of the sun, and where it is more or less protected from the hot winds that generally blow from the south.

The country is new, being first settled lawfully by whites in 1899, but it is already producing large crops of apples, peaches, pears, grapes, plums, apricots, cherries, strawberries, blackberries, dewberries, muskmelons, watermelons, cabbages, onions, sweet potatoes, tomatoes, cucumbers, etc.

The adaptation of fruits to climates, soils and location with reference to the prevailing winds is a subject that is being carefully studied by the horticulturists, and with the possibilty of irrigation by means of pumps and wells this industry will annually grow into prominence.

GRANVILLE LOWTHER

Production of Fruits in Oklahoma

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total...	....	2,745	1,388	2,310,367	$202,291
Strawberries	1,182	825	626	830,404	71,296
Blackberries and dewberries	6,220	1,792	683	1,366,497	119,654
Raspberries and loganberries	387	85	43	74,104	6,851
Currants	212	36	11	31,024	3,559
Gooseberries	151	7	10	8,276	923
Other berries	2	(2)	15	62	

[1] Includes Indian Territory.

[2] Reported in small fractions.

Blackberries and dewberries are the most important of the small fruits raised in Oklahoma, with strawberries ranking next. The total acreage of small fruits in 1909 was 2,745 and in 1899, 1,388, an increase of 97.8 per cent. The production in 1909 was 2,310,000 quarts, as compared with 1,476,000 quarts in 1899, and the value was $202,291 in 1909, as compared with $92,223 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899[1]
	Farms reporting	Number	Farms reporting	Number	Quantity[2]	Value	Quantity[2]
Orchard Fruits, total		8,880,445		5,307,392	1,137,288	$943,464	661,334
Apples	47,578	2,955,810	39,172	2,060,384	742,182	573,076	333,800
Peaches and nectarines	66,111	4,783,825	33,046	2,574,680	357,644	326,315	304,663
Pears	24,910	207,271	19,899	252,336	7,450	9,248	4,939
Plums and prunes	32,991	436,421	18,126	195,836	25,916	28,134	12,037
Cherries	29,530	295,042	16,643	150,541	2,372	4,393	3,221
Apricots	20,845	173,515	8,023	62,930	1,123	1,270	569
Quinces	1,842	28,561	1,130	10,685	601	1,028	(3)
Unclassified			.....	....	.		[4] 2,105
Grapes	26,039	2,388,213	8,947	447,489	3,762,727	122,045	6,344,031
Nuts, total	.	[5] 128,431	.....	[5] 67,372	[5] 1,019,238	[5] 62,168	45,330
Persian or English walnuts	252	6,889	198	5,962	6,700	489	....
Pecans	1,296	96,766	480	53,796	894,172	59,481	16,580
Black walnuts	470	21,412	208	7,204	94,659	1,591	(3)
Hickory nuts	12	631	3	21	21,250	485	(3)
Unclassified		.	....	.	.	. .	[4] 28,750
Tropical Fruits (figs)	63	668	84	520	323	33	....

[1] Includes Indian Territory.
[2] Expressed in bushels for orchard fruits and pounds for grapes, nuts and figs.
[3] Included with "unclassified."
[4] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[5] Includes hazelnuts, butternuts, almonds, chestnuts and other nuts.

The total quantity of orchard fruits produced in 1909 was 1,137,000 bushels, valued at $943,000. Apples contributed nearly two-thirds of this quantity; peaches and nectarines most of the remainder. The production of grapes in 1909 amounted to 3,763,000 pounds, valued at $122,000, and the production of nuts to 1,019,000 pounds, valued at $62,000.

The production of all orchard fruits together in 1909 was 72 per cent more in quantity than that in 1899, while the production of grapes decreased decidedly. The value of orchard fruits increased from $383,000 in 1899 to $943,000 in 1909, while that of grapes decreased from $135,000 in 1899 to $122,000 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899[1]
Cider	455	0.2	Gals.	30,081	36,823
Vinegar	713	0.4	Gals.	32,887	25,830
Wine and grape juice	418	0.2	Gals.	16,999	35,283
Other dried fruits	763	0.4	Lbs.	45,684	30,000

[1] Includes Indian Territory.

Frost and Precipitation for Oklahoma

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Beaver	Oct. 23	Apr. 13	Sept. 27	Apr. 30	18.9
Jefferson	Oct. 29	Apr. 15	Oct. 8	May 1	26.9
Stillwater	Nov. 2	Apr. 11	Oct. 14	May 1	31.7
Arapaho	Oct. 24	Apr. 11	Oct. 8	May 1	27.2
King Fisher	Oct. 27	Apr. 12	Oct. 14	May 1	33.1
Oklahoma	Nov. 2	Apr. 5	Oct. 7	Apr. 30	31.7
Mangum	Nov. 2	Apr. 3	Oct. 16	May 1	25.4
Fort Sill	Oct. 29	Apr. 4	Oct. 14	May 1	30.1
Healdton	Oct. 31	Apr. 7	Oct. 14	May 1	32.7
Lehigh	Oct. 21	Apr. 4	Oct. 8	Apr. 18	35.1

Okra

Okra is a tropical plant, somewhat resembling cotton in appearance, the pods of which are used in soups. There are several varieties of okra, the pods varying in color from a dark green to a greenish white, and in length from one and one-half inches to five inches when ready for use, that is before the seeds are half grown. The pods are usually ready to pick about the second day after the blossom has fallen. This, of course, varies with the vigor of the plant and with the season.

Okra may be grown in almost any rich mellow soil where corn would do well and requires about the same treatment as corn. In the Northern states the seeds should be planted as soon as the ground is warm enough for general gardening. In the South successive plantings may be made about four or five weeks apart.

In countries where okra is used to any great extent the very young pods are strung on threads and dried for winter use.

Methods of Preparing

Okra should never be cooked in iron, brass or copper vessels, as the pods will absorb the metal and become discolored and even poisonous. Agate, aluminum, porcelain or earthenware should be used.

Okra Soup

2 pounds of beef, without fat or bone;
2 cups of okra, chopped fine;
One-fourth pound of butter;
4 quarts of cold water;
1 onion, sliced and chopped;
Salt and pepper.

Cut the beef into small pieces and season well with pepper and salt. Fry it in the soup kettle with the onion and butter until very brown. Then add the cold water and let it simmer for an hour and a half. Add the okra, and let it simmer gently for three or four hours longer.

Winter Okra Soup

1 can of good New Orleans okra;
1 can of tomatoes;
2 onions, chopped fine;
2 tablespoonfuls of butter;
1 dozen oysters;
3 tablespoonfuls of rice;
A red pepper pod, without the seeds.

Chop the onions and fry them in the butter. Wash the rice well, then stew the onions, tomatoes and pepper together in about three quarts of water and one pint of oyster water, for about three hours, stirring frequently. Ten minutes before serving add the okra and let it come to a boil. Then drop in the oysters, boil up once, and serve.

Okra Gumbo

1 chicken;
1 onion;
One-half pod of red pepper, without the seeds;
2 pints of okra, or about 50 pods;
2 large slices of ham;
1 bay leaf;
1 sprig of thyme or parsley;
1 tablespoonful each of lard and butter;
Salt and cayenne to taste.

Clean and cut up the chicken. Cut the ham into small squares or dice and chop the onion, parsley and thyme. Skin the tomatoes and chop fine, saving the juice. Wash and stem the okras and slice into thin layers of one-half inch each. Put the lard and butter into the soup kettle and when hot add the chicken and the ham. Cover closely and let it simmer for about ten minutes. Then add the chopped onions, parsley, thyme and tomatoes, stirring frequently to prevent scorching. Then add the okras, and when well browned add the juice of the tomatoes, which imparts a superior flavor. The okra is very delicate and is liable to scorch if not stirred frequently. For this reason many Creole cooks fry the okras separately in a frying pan, seasoning with the pepper, cayenne and salt, and then add them to the chicken. Equally good results may be obtained with less trouble by simply adding the okra to the frying chicken and watching constantly to prevent scorching. The least taste of a "scorch" spoils the flavor of the gumbo. When well fried and browned, add about 3 quarts of boiling water and set on the back of the stove to simmer for about an hour longer. Serve hot with nicely boiled rice. Round steak may be substituted for chicken, but it must be borne in mind that the chicken gumbo is the best flavored.

Another recipe for okra gumbo which is very similar to the one just preceding, the manipulation being practically the same, is as follows:

1 quart of tomatoes, sliced;
2 pounds of good beef, cut in small pieces;
2 quarts of okras, sliced;
4 tablespoonfuls of butter;
One-half pound of corned ham or pork, cut up;
Small piece of red pepper, without the seeds;
Spray of parsley.

Okra Salad

Boil the young okra pods whole. When cold, dress with vinegar, salt and pepper, or, if preferred, use plain French dressing and serve very cold. This is a most delightful summer salad, the okra being very cooling.

Boiled Okra

1 quart of young okra;
1 tablespoonful of vinegar;
Salt and pepper to taste.

Wash the okra well in cold water and place in a porcelain or agate saucepan. Add a pint of water and a teaspoonful of salt. Cover the saucepan and let the okra simmer for about half an hour. Place in a dish, season with salt and pepper, pour over the okra a tablespoonful of tarragon vinegar and set to cool. Serve as a salad with roast meats, etc.

Baked Gumbo

Place a thin layer of rice in a baking dish, add a layer of sliced okra, then a layer of sliced tomatoes; add salt, pepper, a little currie and a small lump of butter. Repeat with alternate layers of rice, okra and tomatoes until the dish is filled. Cover and bake in the oven until the rice is thoroughly cooked. Remove cover and brown on top. Serve in the baking dish. The rice should be washed in cold water before using, and the okra pods and tomatoes washed and sliced rather thinly.

OKRA DISEASES

Okra Wilt

Neocosmospora vasinfecta (Atkinson) Erw. Smith

This is one of the cotton wilts and is due to a fungus which attacks the plants under all varieties of climatic conditions. It is a soil fungus which persists in spite of severe temperature changes. Plants in sandy soils seem to be affected more than in heavier soils.

Control

No adequate control measure has been worked out for this disease and the selection of resistant varieties is the only suggestion made.

Literature

Duggar. Fungus Diseases of Plants.

OKRA PESTS

The Japanese or Mexican Wax Scale

Ceroplastes ceriferus (Anderson)

General Appearance

The adults look like lumps of dough stuck to the branches. The body proper is black and about the size of a garden pea, with a prominent posterior tubercle or pygidium. The waxy covering is very thick, making the diameter of the scale

from one-fourth to three-fourths of an inch. The color of the protecting coat varies from white to cream.

Life History

The young hatch beneath the scale and soon after leaving settle to feed first upon the leaves and then upon the stems and young branches. The wax shell forms with the growth of the females. There are from three to four broods a year, covering a period from April to November.

Distribution

In greenhouses, and taken in quarantine from Japan, Mexico, India, Australia, Ceylon, Hawaiian islands and South America.

Food Plants

Hibiscus, Camellia, Gardenia, Myrica cerifera, tea, mango and orange.

Control

Spraying should be done before the waxy covering is formed. Resin wash or kerosene emulsion is recommended.

WHITE PEACH SCALE. See *Peach Pests.*

Olive

The olive is an evergreen with leathery leaves, small whitish flowers and a bluish black oily fruit containing a bony two-celled stone. The common cultivated olive (*Olea sativa*), a variety of the true wild olive, is now generally believed to be a native of Western Asia and has been cultivated from very early times for the oil yielded by its fruit. The tree grows slowly, attaining a height of 40 feet, and has great tenacity of life.

Fig 1. An Olive Grove in Palestine Over Two Thousand Years Old.
—*Courtesy Natomas News.*

The species from which our modern cultivated varieties have come is called *Olea europaea*, from the genus Olea, including about thirty species. It is very widely distributed over the countries about the Mediterranean sea, South Africa and New Zealand. The wild olive is rather shrubby and thorny, but in the cultivated forms the tree grows to be larger, more compact and loses its spinous or thorny character, while the shoots become more or less angular.

Soils Best Adapted

In all countries where the olive has been grown, it has been demonstrated that limestone or calcareous soils are the best. Also that the salt sea breezes are favorable to its health and vigor. The environment of the sea, both in the nature of the soil and climate, seems well adapted to the growing of olives.

How Propagated

The olive roots in favorable soil almost as easily as the willow, therefore is most easily propagated by cuttings or layers. If the tree is cut down numerous suckers spring up around the stump and these suckers may be cut into lengths of several feet each and planted rather deeply in manured soil; or short pieces are sometimes laid in shallow trenches and when covered with a few inches of soil they rapidly throw up suckers or shoots. In some places grafting is a common practice, and in others plants are raised from seed.

Cultivation

In the Eastern countries the olive is allowed to grow wild in many sections, in which case it bears a crop every two or three years. In California it is planted and cultivated much the same as other orchard fruits and pays a big return on the labor expended in pruning, irrigating and cultivating. There are certain dwarf varieties with very green and very superior fruit which bear in about three years, whereas the old varieties would not bear until at least twice that age.

Pickling the Olive

The unripe fruit of the olive is used in modern, as in ancient times, as an

article of dessert, to enhance the flavor of wine and to renew the sensitiveness of the palate for other viands. For this purpose the fruit is picked while green, soaked for a few hours in an alkaline fluid or lye, washed well in clean water and then placed in bottles or jars filled with brine. Sometimes spices are used to increase the bitter flavor.

In California many orchardists pickle ripe olives and claim for them superior quality and taste to that of the green olive. They also claim that the demand is greater than the supply. Ripe olives for pickling are generally purchased by packers before picking at prices ranging from $100 to $125 per ton. At the packing house they are graded according to size in three classes, viz., extra large or fancy, large, and medium.

W. W. Hinsey describes the process of pickling ripe olives as follows:

First, treatment to extract the bitterness; second, soaking in water to eliminate the lye; and third, gradually salted to suit taste.

To extract the bitterness, the olives are soaked in a vat containing a solution of water and caustic potash. If the olives are very bitter they are put through a second soaking with fresh lye. A floating cover is used to keep the olives submerged in the solution and the lye is frequently drawn from the bottom and poured over the top to insure equal distribution.

When the color of the olives indicates that the lye has penetrated to the pits, it is immediately drawn off and fresh water used to remove the lye. They remain in this vat, the water being frequently changed, until the lye has been thoroughly eliminated.

After the lye and bitterness have been extracted the olives are gradually salted to taste and prepared for use. Special care is always used to keep the olives from hardening or shrinking and the soaking in lye and salt has to be done gradually and painstakingly.

The olive is now ready for packing. Some packers put up a natural or or-

Fig. 2. Olive Grove in Sacramento County, California.
—*Natomas News*

chard run of fruit. Other packers carefully select and keep separate different colored fruit and they are marked light, brown or dark as the case may be. Uniformity of color is usually desired and this is accomplished by picking fruit of equal ripeness and treating it with uniform solutions of lye and salt. The olives are packed in bottles, cans or barrels, which are properly sterilized, labeled and cased for shipment.

Districts Where Grown

District No. 16

HIGHLY RECOMMENDED: Mission.

RECOMMENDED: Ascolano; Macrocarpa; Rubra; Santa Catarina; Uvaria.

RECOMMENDED FOR TRIAL: Manzanillo.

District No. 17

HIGHLY RECOMMENDED: Manzanillo; Mission.

RECOMMENDED: Nevadillo *Blanco;* Rubra.

District No. 18

HIGHLY RECOMMENDED: Manzanillo; Mission; Nevadillo *Blanco;* Rubra.

RECOMMENDED: Ascolano; Columella; Oblonga; Pendulina; Regalis; Santa Catarina; Sevillano.

OLIVE DISEASES

Dry Rot

Characterized by the appearance of numerous large spots on the fruit which dry and sink in. During some seasons the olive is considerably affected with this trouble. Cause not known.

Leaf Spot

Cycloconium oleaginum

Causes spots of considerable size on the leaves. No treatment is usually necessary.

ROOT ROT (TOADSTOOL DISEASE). See *Apple Diseases*.

Tuberculosis

Bacterium savastanoi

This is a bacterial disease, the parasitic organism causing a production of galls of considerable size on the trunk, branches and small twigs. Some varieties are more susceptible than others. If taken in time the disease can be successfully controlled by cutting out all affected parts and saturating the wounds with a strong disinfectant.

References

Bulletins 120 and 218, California Experiment Station.

OLIVE PESTS

BLACK CITRUS LOUSE. See *Orange Pests*.

BLACK SCALE. See *Apricot Pests*.

Chrysomphalus rossi Mask.

General Appearance

The scale of the adult female is circular or irregularly oblong with ragged margins; flattened; reddish to dark brown, with inner surface around and including exuviae almost black. The male scale is smaller and lighter in color. The female body is reddish yellow and about one and five-tenths millimeters long. The eggs are light purple and hatch soon after being laid. The first hatched larvae are pink.

Distribution

Imported into California from Asia and Australia and now occurs in the central and southern parts of California.

Food Plants

Attacks *Araucaria bidwillii.* Also works on olives.

Natural Enemy

The steel-blue ladybird beetle, *Orcus chalybeus*, preys upon this scale.

E. O. ESSIG

CITRUS THRIPS. See *Orange Pests.*

GREEDY SCALE. See *Apple Pests.*

IVY SCALE. See *Apple Pests.*

PINEAPPLE SCALE. See *Pineapple Pests.*

PURPLE SCALE. See *Orange Pests.*

RED SCALE. See *Orange Pests.*

OLDENBERG APPLE FOR MASSACHUSETTS. See *Massachusetts.*

Onion

The onion in one or more of its several forms has been in use throughout all time of which we have authentic history. From available records it would appear that the original home of the onion was in Southern Asia or in the countries surrounding or bordering on the Mediterran-

Alsie Craig.

ean sea. During early times the onion was highly esteemed as an article of food, also as a preventive of thirst while on the march or traveling in the desert. In olden times the production of onions was confined to the alluvial river valleys, but the improvement and adaptation of varieties has made it possible to grow this crop under widely diverse conditions.

The onion belongs to the widely variable species *Allium cepa*, which forms part of a family of plants which includes many of the lilies, the several forms of asparagus and smilax, and similar plants having a scaly or fleshy enlarged root. A characteristic of this family is that most of its species grow naturally upon soil having an abundance of moisture, many of them being natives of low-lying areas along the seashore. Another charactertistic of plants like the onion and asparagus is that they will withstand considerable salt in the soils on which they grow. The onion is grown primarily for its bulb; however, the leaves are often employed for seasoning, and there are several kinds that are grown for their leaves only.

The onion holds third place among the truck crops grown in the United States. In 1908 about 14,000,000 bushels, valued at $10,000,000, were produced, practically all of which were consumed in this country. In addition we annually import about 1,400,000 bushels from Spain, Egypt, Bermuda, and the South Sea Islands. The onion is one of the more common crops of our home vegetable gardens, and it is well adapted to growing commercially on a small scale, very little capital being required for a beginning. The market for onions includes practically the entire commercial world, and the demand for a good article continues throughout the entire year.

During recent years the production of the various forms of Spanish and Bermuda onions in the Gulf coast states has become an industry in itself. Owing to the great quantity of this type of onion that can be grown upon a small area, a few thousand acres will produce all that the market can handle at a profit to the grower. In the alluvial delta region of the Mississippi river, the Egyptian onion is being grown to perfection, and there are doubtless regions bordering the Gulf of Mexico where the famous Denian onion may be produced as successfully as in its native Spain.

Areas Adapted to Onion Culture

The onion is exceptional in that it will thrive under a very wide range of climatic and soil conditions. The crop is grown to perfection in the alluvial valley of the Nile river in Egypt, on the volcanic soils and under the tropical sea breezes of the South Sea Islands, along sandy coastal plains, in the irrigated portions of the arid regions, on sandy uplands, and on reclaimed swamp soils. There is perhaps no extended area in the United States, except the mountainous regions, where the onion can not be successfully grown.

Climatic Requirements of the Onion

For best results a temperate climate without great extremes of heat and cold should be selected. Onion culture is rarely profitable in regions where the climate does not change or has no definite

seasons of heat and cold or wet and dry. Naturally the onion does best under rather cool conditions, with plenty of moisture during its early stages, but requires a reasonable degree of heat, together with dryness of both soil and atmosphere, for its proper ripening. Where the onion industry has become established in the extreme southern part of the United States, the growing season is during the late autumn and winter, the crop maturing during the spring and early summer. If the crop matures at a time when there is considerable rainfall, it will be impossible to cure the bulbs and they will be lacking in keeping qualities.

Certain types and varieties of onions, including the "top onions" and the "multipliers" or "potato onions," are extremely hardy and may remain in the open ground throughout the winters of our Northern states, especially if given slight protection. These types are, however, not adapted to growing for market, except as green onions, "peelers," or "bunchers," to be sold during the early springtime. In certain sections of the South Atlantic coast region large areas of the top and multiplier onions are grown for this purpose. There is also a marked difference in the hardiness of the standard commercial sorts, some being adapted to growing far northward, while others, like the Bermuda, Egyptian, and Spanish types, thrive only in restricted southern localities.

Length of Season Required for Onions

The period required for the production of a crop of onions will depend upon the season, the methods employed in growing, and the variety. If grown from seed, a period of from 130 to 150 days will be required. If from sets, the crop may often be matured in 100 days. If grown in the extreme northern part of the United States, where the seasons are short, the crop will mature more rapidly than to the southward. Onion seed grown at the North will as a rule produce mature bulbs in less time than that produced in a warm climate. In the case of the Bermuda onion, as grown in Texas, the growing season extends from the middle of September to the following March or April.

Rainfall or Irrigation

Onions require an abundance of moisture during the early stages of their growth, but should be ripened under comparatively dry conditions. In most sections the seed is sown at a time of the year when frequent spring rains occur. Their period of greatest growth is during the early part of the summer, and the crop is ripened late in the summer when drying conditions may be expected. In irrigated regions the application of water is almost entirely under the control of the grower. During the active period of growth the water is applied about once a week, the soil being thoroughly soaked and the surplus water drawn off.

The amount of rainfall or irrigation required for the production of a crop of onions will depend largely upon the character of the soil and its drainage. Many of the peat or muck soils in which the soil water remains near the surface will require very little rainfall; in fact, the best crops of onions are produced on these soils during seasons of comparatively light but evenly distributed rainfall. Sandy and loose soils generally will require a greater amount of water, especially during the early part of the season. Excessive rainfall or irrigation will have a tendency to produce onions having a large growth of leaves and stems at the expense of the bulbs. Onions of this character are commonly termed "thick necks" or "scullions."

Soils Adapted to Onion Culture

The essential requirements of a soil upon which to grow onions profitably are a high state of fertility, good mechanical condition in order that the crop may be easily worked, sufficient drainage, and freedom from weeds. If a soil has the proper mechanical properties—that is, if it contains sufficient sand and humus to be easily worked, is retentive of moisture and fertilizers, and is capable of drainage—all other requirements can be met. At least three types of soil are being extensively planted to onions in this country,

the one common essential being proper mechanical condition.

Clay and Alluvial Loams

Soils of this character abound in the river valley and delta regions near the coast. These soils are generally very fertile, but will require the addition of humus or stable manure in order to lighten them. The greatest difficulty encountered in growing onions upon land of this character is the tendency of the soil to run together and bake after hard rains. This is especially injurious after the seed has been sown and before the small plants have attained sufficient size to permit of stirring the soil about them. Where these soils contain considerable sand they are ideal for onion culture. It is upon this class of soil that the greater part of the Bermuda, Spanish, and Egyptian onions are grown.

Sandy Loams

Sandy soils, especially where underlain by a well-drained clay subsoil, are often well adapted to onions. Soils of this character generally require heavy applications of fertilizers before they will produce a paying crop, but the quality of the product is excellent. Onions grown on sandy loams are generally solid, heavy, and of excellent keeping quality. Where sandy soils are lacking in humus this may often be supplied by means of crops of crimson or other clover grown upon the land and plowed under when it has attained its greatest growth. The use of leguminous crops should be supplemented by occasional applications of 1,000 to 1,200 pounds of lime to the acre.

Muck and Peat Soils

Throughout the north-central part of the United States there are vast tracts of peat or muck soils that are capable of producing onions. Before planting to onions, however, these soils must be cleared, drained, and brought to a suitable state of cultivation. In many cases this process will require two or three years' time, but sometimes the soil can be broken during the early winter, allowed to lie exposed to the action of frost for a few weeks, and planted to onions the following spring. Some of the largest onion farms are located on muck lands, and there are still great tracts of this class of soil waiting to be reclaimed.

The store of plant food in muck soil is usually large, but often it is not in available condition, and heavy applications of manure and commercial fertilizers, such as lime and potash, are essential to profitable crops.

Cultural Methods

The onion belongs to that class of crops which gives best results under very intensive culture, and the greatest yields are secured where a moderate acreage is planted and the work conducted in a most thorough manner. There is nothing technical or difficult about the growing of onions, but close attention and frequent cultivation are essential. Once the weeds get a start, the cost of production will be greatly increased, or the crop may be lost altogether.

Preparation of New Land

As a general rule new land is not adapted to onion growing until it has been worked one or two years with other crops. Onions should follow some crop that has been kept under the hoe and free from weeds the previous season. Corn, beans, and potatoes are suitable crops with which to precede onions. Muck and sandy soils may in some cases be brought to a suitable condition for onions the first season, but the fitting will have to be very thoroughly performed. The land should be plowed in the autumn, then replowed in the spring, after which numerous harrowings and doubtless some hand work will be required to get the soil in suitable shape.

If necessary to manure the land heavily before planting to onions, it will be desirable to plant to some farm crop one season, then apply the manure during the autumn in order to give it time to become incorporated with the soil. Owing to the value of good onion land it would not be advisable to devote it to general farm crops for any extended period, although corn is frequently planted and oats or rye are sometimes used in the North.

Cow peas may be of great service in bringing new land into shape for planting to onions.

Crop Rotation

Onions should not be planted on the same piece of land year after year, and some system of crop rotation should be maintained. Care should be taken, however, to use crops in the rotation that will not be exhaustive of the high fertility necessary in the onion land. During the years when the land is not devoted to onions it can be planted to some truck crop that will give a return that will justify the application of large quantities of fertilizers, or, better, to a leguminous crop to be turned under as green manure. Continuous cropping with onions will cause the land to become infested with both disease and insect enemies that will sooner or later injure the crop to such an extent as to render it unprofitable.

Preparation of the Soil

Assuming that the land intended for planting to onions is capable of being brought to a good mechanical condition, fertile, well drained, and reasonably free from weed seeds, the first step in the production of the crop will be to plow moderately deep, then harrow, disk, roll, and drag until the soil is smooth and mellow to a depth of four or five inches. The method of preparing the soil will depend somewhat upon its character, the manner of planting to be followed, and the requirements for irrigation. There are few truck or other crops that require so careful fitting of the soil as do onions, and it is essential that the fertilizers be well mixed with the soil.

On soils that are naturally well drained and where surface water can not accumulate, the plowing may be done in large blocks, but where the opposite conditions are found or irrigation is practiced it may be necessary to plow the land in narrow beds. In the case of insufficient drainage it will be desirable to throw the soil together into beds, leaving a double furrow between each bed to carry off surplus water. Where the flooding system of irrigation is practiced the beds must be leveled and a system of ditches and ridges provided for distributing and controlling the water. Where it is merely desired to secure surface drainage the beds may be from 75 to 150 feet in width, but for irrigation purposes the beds are generally but 12 or 15 feet in width. If spring plowing is practiced the soil should be harrowed closely behind the plow in order to prevent drying out.

For cutting and pulverizing the soil there is perhaps no tool as serviceable as the disk harrow. There is a type of disk having four gangs, in two sets, one combination in front of the other and so arranged that the soil is first turned to the center and then turned outward again by means of the rear combination. This tool turns the soil twice and leaves it in a level condition.

For imparting the final smoothing touch to the soil before planting there is a device consisting of a large number of small disks set in a wooden frame which does about the same work as a steel rake, but in a rapid manner. A drag or float made from several pieces of scantling nailed together may be used for this purpose, or if the soil is very loose a roller should be run over it. The final leveling should be performed with a tool that will fill and obliterate all tracks or other depressions in the soil, leaving a smooth, even seed bed for either seed sowing or transplanting.

Fertilizers

As the onion is an intensive crop and yields great quantities of marketable bulbs for the area planted, the grower is justified in manuring heavily. It would be difficult indeed to make the soil too rich for onions provided the manures are thoroughly incorporated with the soil. A heavy application of fresh raw manure just before planting would have an injurious effect, but where the manure is well rotted and uniformly applied there is nothing to be feared.

Commercial fertilizers should not be applied until shortly before sowing the seed and should be uniformly distributed and thoroughly worked into the soil. There are one-horse fertilizer distribu-

tors that scatter the fertilizer broadcast, but where an amount not exceeding 1,000 pounds of fertilizer to the acre is being used the work of distribution may be performed by means of a common grain drill having a fertilizer attachment. On a small scale the work is generally performed by hand.

Transplanting Method of Growing Onions

The transplanting process, often spoken of as the "new onion culture," is merely a modification of the regular seeding method. The objects gained by transplanting are an earlier crop, a uniform stand, and bulbs of more regular size. Practically the entire Bermuda crop of the Southern states is handled in this manner. Where a small area is to be grown, the transplanting process is the ideal method, but for large acreages and where labor is difficult to obtain this would not be practical. After transplanting, the seedlings will require rain or watering in order that they may start, and for this reason the transplanting process is practically limited to areas where some form of irrigation is available.

Propagation by Sets

The use of sets is still another modification of the regular seedling method, in which the seed is planted one year to form the sets from which to grow a crop of mature onions the following year. Like the transplanting process the use of sets is limited in its application. Onions grown from sets will ripen earlier than those from seed sown in the field, but the use of sets for commercial onion growing is not so practical as transplanting seedlings. In planting onion sets a furrow about two inches deep is opened, the sets being dropped about three inches apart and firmly covered. For best results the sets should be placed in an upright position. The quantity of sets required to plant an acre will depend upon their individual size and planting distances, but it is generally between eight and nine bushels. The price of sets at planting time is generally about $2.50 a bushel, or $20 for an acre.

Methods of Tillage

The cultural requirements of the onion are frequent shallow stirring of the soil and freedom from weeds. The feeding roots of the onion run close to the surface of the soil and should not be disturbed by deep cultivation. Sometimes a heavy

Fig. 1. Special Wheel Hoes for Cultivating Onions.

rain immediately after seeding will so pack the surface that the seedlings can not break through. Under such circumstances it will be necessary to slightly break the surface by means of a steel rake or a rake-like attachment on a cultivator. As soon as the plants are up and the rows can be followed the cultivator should be started to loosen the soil, which is always more or less compacted during seeding.

Hand Cultivation

Where the rows are 14 inches or less apart, the work of caring for the crop must all be done by hand. For this purpose the wheel-hoe tools of various types are essential. These implements are provided with several kinds of hoes, cutters, and sweeps designed to work the soil away from the plants, to shave the surface and destroy weeds, and to stir the

Fig. 2. High-Wheel Type of Hoe (Patented).

soil and work it back around the plants. Onions grown on muck and alluvial soils will require from eight to 14 workings with the wheel-hoe implements; on shady soils it will not be necessary to cultivate so frequently.

Several types of wheel hoe are in use, but those having a single wheel and passing between the rows are most desirable. Many growers have designed special implements to suit the requirements of their soils; two of these are shown in Fig. 1, the one designed to cut the soil away from the row and the other to stir and work the soil back to the row.

Horse Cultivation

In sections where onions are grown on a soil that is not well adapted to hand culture the rows are placed 30 to 36 inches apart and the cultivation is performed by means of horse-drawn tools. This is particularly true where onions are grown on the "black waxy" soils of Texas and other soils of the prairie type.

Hand Weeding

It is well-nigh impossible to produce a crop of onions without some hand weeding. During favorable seasons the strictly hand work may be reduced to but one or two weedings, but a greater number will be necessary during rainy seasons. Each hand weeding will cost from $5 to $12 an acre, according to wages paid and the number of weeds present. The work of hand weeding may be facilitated by the use of some of the small hand tools designed for the purpose.

Propagation

Most of the onions grown in the United States are propagated from seed. Propagation from seed is conducted by three more or less distinct methods: First, by sowing the seed in the rows where the crop is to grow and mature; second, by sowing the seed in specially prepared beds and transplanting the seedlings to the open ground; third, by first growing sets from seed and then, after keeping through the winter, planting them in the field to produce the crop of mature bulbs. Of these three methods the one first mentioned of seeding in the rows where the crop is to mature is the only one that is practical on a very large scale.

Planting the Seed

In the northern onion-growing districts the seed is sown as early in the spring as the soil can be brought to the proper condition. While it is desirable to plant quite early it never pays to sow the seed before the land is in the best possible condition. When the soil has been brought to a smooth, even surface and is fine and mellow, the seed is sown

by means of one of the common seed drills, of which there are several makes upon the market. The hand drills which sow one row at a time are extensively employed, but many of the larger growers employ a gang of drills hitched together and plant from five to seven rows at once. A more even distribution of the seed will be secured by the use of the single-row hand drill, owing to the closer attention that can be given. In heavy or moist soils the depth to cover the seed should not be more than one-half to three-fourths inch, while on loose and sandy soils the seed may be covered an inch or more.

Planting Distances and Seed Required to Plant an Acre

Where hand cultivation is practiced throughout, the usual distance between rows is 12 or 14 inches. Where horse culture is employed the distance between rows varies between 24 and 36 inches. The quantity of seed required to plant an acre will depend both upon the distance between rows and the purpose for which the onions are being grown. For the growing of standard market onions in rows 14 inches apart, about four and one-half pounds of first-class seed will be required. With the rows three feet apart, but one and one-fourth or one and one-half pounds will be necessary. Where it is desired to produce small onions for pickling purposes, the amount of seed may be as great as 25 pounds to an acre. Good seed is essential, and if there is any doubt regarding the vitality of the seed it should be tested before planting by counting and planting four or five hundred seeds in a window box and then determining the germination by counting the seedlings after ten days' or two weeks' time. There are dealers who make a specialty of securing and furnishing extra-quality onion seed, and while their prices are often somewhat above the general market the seed furnished by them is always preferable to ordinary seed.

Thinning

Experienced growers are frequently able by using extreme care in regulating the drills to distribute onion seed in rows where the crop is to mature so that little thinning will be necessary. Thinning is generally left until the time of the first hand weeding, when all thick bunches along the rows are thinned to a uniform stand of eight or ten plants to the foot. It is always well, however, to allow for considerable loss of plants, and unless the plants are so thick as to actually crowd, thinning will not be necessary.

Harvesting and Curing

In the northern onion districts the crop ripens and is harvested during the latter part of the summer and early autumn. As a rule the work of harvesting onions begins late in July and is practically completed and the crop housed before October first. In the Southern states, where the crop is grown during the winter, the

Fig. 3 Field of Onions in Condition for Gathering

harvesting and marketing period is during the spring months and is practically ended before the Northern product comes upon the market.

Condition of Bulbs When Ready to Harvest

In the North the bulbs are allowed to become as ripe as possible before removing them from the soil. Growers prefer that the tops ripen down and shrivel and that the outer skin of the bulbs be dry before they are pulled. Fig. 3 shows a field of onions in prime condition for gathering. To the southward, where the onions are not cured so thoroughly, they are often pulled about the time that the tops begin to break and fall. The ripening process may often be hastened by rolling a very light roller or a barrel over the tops to break them down. This process is frequently spoken of as "barreling."

Methods of Handling the Bulbs

Where the bulbs are practically upon the surface they may be pulled by hand and thrown in windrows consisting of eight or ten onion rows. If the onion bulbs are considerably covered with soil it will be necessary to employ a one-horse plow or a cultivator with a sweep attached for lifting them. In any case it will be necessary to gather them from the soil by hand. After lying in the windrows for several days and being stirred occasionally with wooden rakes they are gone over and the tops removed either by twisting or cutting with ordinary sheep shears. In cases where very bright color is important, as with fancy White Globe onions, and this would be injured by exposure to the sun and rain, the bulbs are cured in long, narrow, low ricks formed by two rows of onions laid with the bulbs regularly to the center, tops to the outside, the rows a few inches apart at the bottom of the rick but coming together at the top, and the top of the rick covered by straw or boards to shed the rain. As the tops are removed the bulbs are generally placed in crates for drying. In some sections onion-topping machines are employed, the bulbs being hauled from the field to a central location and run through the topper. These machines remove the tops, grade the bulbs, and deliver them into the crates or bags. If crates are not employed for curing, the bulbs are allowed to lie in the windrows for some time, and are then either put into sacks or hauled to slat cribs, where they complete the curing process. Too long exposure to hot sunshine will injure the bulbs. Fig. 4 shows a field of onions drying in windrows, with crates ready for their removal from the field.

Fig. 4. Onions Drying in Windrows, Showing Crates Used for Curing and Storing.

Fig. 5. Method of Curing Onions in Sacks Standing in Field.

After gathering into crates the crates are either stacked in the field, hauled to a central stacking yard, where the stacks of crates are covered with boards or canvas, or hauled to open sheds and there piled one upon the other with numerous air spaces until the onions are thoroughly cured.

Where the bulbs are extremely dry at the time of their removal from the soil, they may be allowed to lie in the windrows for a few days only and then sorted and cleaned in the field ready for packing and marketing. Where onions are put into sacks and afterwards allowed to remain in the field, the sacks should be supported on poles laid upon the ground, as shown in Fig. 5.

In the Bermuda onion districts, where very little attention is given to the curing of the crop, it is the practice to pack and load into the cars as soon as possible after pulling and topping. When the shipping is at its height, it is not uncommon for onions that are pulled from the soil in the morning to be in the cars and on their way to market by evening; however, a portion of the crop is given a more thorough curing process, and the entire crop would be benefited by at least two days of curing before shipment.

Storage

In order that onions should keep well when stored they must be well ripened and thoroughly cured. Those that are immature, soft, or "thick necks" should never be placed in storage but sold as soon as gathered for whatever price they will bring. Good storage onions will rattle almost like blocks of wood when poured from one crate to another. In order that the bulbs may remain bright and of attractive appearance they should not be allowed to lie exposed to the weather, but should be hauled and stored in open sheds just as soon as they may safely be placed in one-bushel crates.

After the bulbs have remained in drying sheds or cribs for several weeks they will be ready for screening and removal to the storehouse. In handling onions it is the rule to pass them over a screen each time they are moved, as in this

way the loose skins are removed and any soft or decaying bulbs may be sorted out. When bags are used for drying in the field, the onions are screened in the manner shown in Fig. 6, and the bags refilled for hauling to the storage house.

In screening, the onions are placed on one end of the screen while the men stand alongside and stir the bulbs about with their hands, passing them along to the opposite end, where the bags are filled.

Conditions Required in Storage

The essentials for the successful storage of onions are plenty of ventilation, storing in small quantities, a comparatively low temperature, dryness, and safety from actual freezing. Any building wherein the above conditions may be secured will answer, but houses of the type shown in Fig. 7, which are built especially for the purpose, are most satisfactory.

The construction of the storage house should be double throughout, with plenty of felt or paper lining. Both top and bottom ventilation should be provided and the ventilator openings should have doors that may be closed to control the temperature. The floors are constructed of narrow planks with half-inch spaces between the planks for the passage of air. Bottom ventilation is frequently secured by means of drain pipes built into the foundation at the surface of the ground. These pipes are carried some distance toward the center of the house and discharge the cool air at a point where it is most needed.

The temperature of the storage house should be carried as low as possible without actual freezing. During extremely cold weather the ventilator openings and doors should be kept closed to keep out cold, and after the onions have become thoroughly chilled the house should be kept closed in order to hold the temperature down and prevent the entrance of moisture during warm or rainy periods. Damp, foggy weather is injurious to onions, especially if it follows a period of cold, and will cause the bulbs to become covered with moisture if the outside air is admitted. A little artificial heat from a stove or radiator may be required during excessively cold

Fig. 6. Grading Onions in the Field by Means of a Screen.

Fig. 7. Onion Storehouses.

weather, but so long as the temperature in the house does not fall below 33 degrees there will be no danger of injury. A temperature of from 34 to 36 degrees will give best results.

Methods of Storing

The best method of storing onions is in standard-size slat crates 20 inches long, 16 inches wide and 14 inches deep, outside measurements. The material for the sides and bottom is about ⅜ inch thick and 2½ inches wide, four pieces being used to form a side. The corners are reinforced on the inside by means of three-cornered pieces of oak, to which the slats are nailed. These dimensions provide crates that are interchangeable, the width of five being equal to the length of four. These crates will also nest together when empty, with one inside of two turned together. The full crates are stacked in the storehouse with 1 by 3-inch strips between them to allow for the circulation of air, as shown in Fig. 8.

Marketing

Large quantities of onions are sold and shipped direct from the fields where they are grown. A part of the crop is held in temporary storage until late autumn or early winter. During recent years the winter storage of onions has become of great importance and the finest stock is held for late winter deliveries. The Bermuda crop from the southwestern part of the country comes upon the market during April and May, so that most of the storage onions are disposed of before that time.

Grading

In marketing onions the first essential is to properly grade and clean the bulbs, in order that they may present an attractive appearance when offered for sale. Ordinarily the bulbs are separated into three grades—primes, seconds and "picklers." The primes include all those of 1¼ inches in diameter and larger, and the seconds consist of those from ¾ inch to 1¼ inches in diameter, while all those that will pass through a ¾-inch screen are sold for pickling purposes. The grading is generally done in the field during the cleaning process, but as onions shrink considerably while in storage it is necessary to regrade before placing upon the market. The type of screen used for grading onions is shown in Fig. 9. For cleaning the pickling onions an ordinary fanning mill is em-

ployed, special screens being provided for the purpose.

Shipping Packages

Onions are placed upon the market in crates, bags, barrels, Delaware baskets, one-half barrel baskets, and in bulk. The folding crate, shown in the foreground of Fig. 9, is undoubtedly the most attractive package in use for marketing onions. The bags employed are of heavy burlap and hold about the same quantity of bulbs as a barrel. The barrel in most common use is the same as is used for shipping early potatoes and holds about eleven pecks. These barrels are constructed of thin staves, have numerous openings for ventilation, and are headed with a piece of burlap. Standard apple barrels having two heads are also used for handling onions. Onions are frequently shipped loosely in cars and shoveled into barrels or bags at their destination.

Weight of Onions

The legal weight of onions per bushel varies somewhat in different states, but 56 pounds of dry onions are generally considered a standard bushel.

Important Commercial Varieties of Onions

Common Market Varieties

The varieties of onions that have distinctively yellow, white and red skins and are of the globular type are of greatest commercial importance. Among the varieties that belong to the yellow globe class are the Prizetaker, Yellow Danvers, Yellow Globe, Danvers, Southport Yellow Globe, and Ohio Yellow Globe. The principal white varieties are Southport White Globe, New Queen, Italian Tripoli, Silver Skin, and White Silver King. Among the more important red sorts are Red Globe, Red Wethersfield, and Australian Brown.

The principal Bermuda varieties are Red Bermuda, White Bermuda and Crystal Wax. The Bermuda onions are all of the more or less flat type. The red coloration of the Bermuda onion is not distinctive like that of the Red Wethersfield or Red Globe varieties, but is lighter in color. The famous Denia onion is somewhat of the Prizetaker type, is light yellow in color, grows to a large size and is mild in flavor.

Fig. 8. Inside of Storage House, Showing Method of Stacking Crates

Fig. 9. Screen Used for Grading and Cleaning Onions, Showing Folding Crates Largely Used for Marketing.

In the selection of varieties for any particular locality the soil conditions and market requirements should both be considered. Those adapted to the muck soils are the yellow and red sorts. For alluvial and prairie soils the red and brown varieties are to be preferred, while all kinds do well on the sandy loams and light soils. A cleaner, better grade of white onions can generally be produced on light or sandy soils than on muck or clay loams. Those of the Bermuda, Spanish and Egyptian types flourish on the deep, rich alluvial soils of the river bottoms and delta regions.

Certain of our markets show a decided preference for onions belonging to a particular type. The red and brown varieties find ready sale on the markets of the Middle West, while onions of the yellow and white varieties are preferred in the Eastern cities. Onions will withstand long-distance shipment, those of the Red Globe type being generally more subject to injury than the yellow and brown sorts. Some of the white varieties also have a thin skin and are easily injured. It should be the aim of every grower to employ varieties that will withstand handling and at the same time find ready sale on the market.

Other Types of Onions

Among the types not already discussed are top onions, multipliers, garlic and leeks, which are planted to some extent for marketing purposes.

The top or tree onion, which reproduces by means of small bulblets formed on the top of a seed stalk, is extensively used in the production of early spring bunching onions.

The multiplier or potato onion reproduces by a division of the bulbs. In growing this variety it is necessary to plant large bulbs to produce sets for the next year's planting and small bulbs or sets for the crop of large onions. The bulbs of this variety may remain in the soil year after year and are desirable for use early in the springtime.

Garlic is closely allied to the onion, but will remain in the ground from one year to another if undisturbed. Garlic is planted by setting the small bulbs, or cloves, in either the autumn or early spring. The culture is practically the same as for the onion.

The leek also belongs to the same class as does the onion, but requires somewhat different treatment. The seed is usually sown in a trench and the plants thinned to about four inches in the row. The plants of the leek are given about the same cultivation as onions, except that after they have attained almost full size the soil is drawn around them to a height of six or eight inches to blanch the fleshy stem. The leek does not form a true bulb like the onion, but the stem is uniformly thick throughout. Leeks are marketed in bunches, like young onions, and they may be stored in cellars for winter use.

Green Onions for Bunching

Another phase of onion culture that is of considerable importance in certain localities is the production of young bunching onions for the early spring trade. In several sections along the South Atlantic coast the growing of this class of onions is quite an enterprise. Many persons who are engaged in other lines of work follow the practice of growing a small area of bunching onions as a side issue.

Type of Onions Employed

The varieties known as multipliers and top onions are generally employed for this purpose; however, bunching onions are sometimes grown from ordinary sets, from inferior and damaged large onions, and from seed. The multipliers and top onions are the only kinds adapted for this work on a large scale.

BERMUDA ONIONS

Production

The production of Bermuda onions in the United States is a comparatively new industry and has thus far been undertaken mainly in Texas and California.

Soils and Climate

Soils of a silty or alluvial nature are suited to the production of Bermuda onions, and those containing considerable sand are most desirable. As already noted in referring to fertilizers for onions, the Bermuda requires a very rich soil for the best results, and this can only be obtained by first selecting a good soil and then manuring heavily. The Bermuda onion as grown in this country is a winter crop; therefore, mild climatic conditions are required.

Cultural Methods

The cultural methods employed in the growing of Bermuda onions are essentially the same as those for ordinary onions. As the greater portion of the crop is grown in a region which has no regular rainfall, irrigation methods are employed almost universally. The greater part of the crop is grown by the transplanting process and a great amount of hand labor is required.

Bermuda onions are harvested as early as possible, generally before the tops have become fully ripened.

Irrigation

Outside of the areas where irrigation methods are depended upon for the production of general crops it is not customary to use artificial watering in the growing of onions. In a few cases the land has been equipped with an overhead sprinkling system which is employed to moisten the soil after the seed is planted and also during extremely dry weather. On peat and muck soils the young seedlings are frequently lost by the dry muck blowing with the high winds of early springtime. In this way a part of the field may have the soil blown off to such an extent that the plants will be left without soil about them, while other portions of the field will be covered by one or two inches of loose muck. The use of a small quantity of water sprayed over the field will prevent this shifting of the soil during a windstorm, and thus save the crop from destruction. Sandy soils are also subject to the action of winds to a greater or less extent, and losses may be prevented by the timely application of water over the surface. In a few instances subirrigation is employed in the growing of onions.

Throughout the Bermuda district of the Southwestern states surface irrigation is almost universally employed. The Bermuda onions are planted mostly in comparatively level beds with dividing ridges and are flooded once each week or ten days during the growing period. About a week before the plants are set the soil is flooded and then worked over with disk and smoothing harrows just ahead of the planters. Within a day or two after planting the land is again flooded and the surface water drawn off; this process is repeated, with alternate cultivations, as often as the land becomes dry. Toward the end of the growing season the water is withheld to allow the bulbs to ripen. As a rule about ten waterings in all are required, at a cost of about $1.50 an acre for each watering, or $15 altogether.

In the principal Bermuda onion-growing districts the water for irrigation purposes is obtained only after the expenditure of thousands of dollars for pipe lines and pumping machinery, and the cost of watering as given above does not include any share of the original cost for installation.

W. R. Beattie,
U. S. Dept. Agr. Farmers Bul. 354

ONION DISEASES

Anthracnose or Black Spot

This is chiefly a disease of stored onions and is more conspicuous with the

white varieties. It causes black circular spots on the bulbs. Store in a dry cool place and avoid piling too deeply in the bins.

See *Smudge.*

Bacterial Diseases. See *Heart Rot*, this section.

Black Neck. See *Dry Rot*, this section.

Blight

Leaf blight or scald of onions during mid-season, when the weather is warm and dry, is rather a common occurence. While often attributable to insects, species of fungi, especially molds, are abundant. It may be possible to check these molds by spraying.

A. D. Selby,
Wooster, Ohio.

Onion Brittle

This disease causes many young seedlings in the field to die suddenly and others to curl up and present a spotted appearance. The cause of the disease is unknown. The trouble usually starts in spots which become larger year after year until the land becomes worthless for onions. Treating the land with formalin has been recommended.

Damping Off. See *Cabbage Diseases.*

Dry or Black Neck Rot

Sclerotium cepivorum Berk.

A serious disease of white onions. The white onions are grown for somewhat special markets and it is the custom to gather early before the tops fall over, to top at once, and put up in crates in order to preserve the white color of the onion. As a rule this is not practiced with black, red or yellow sorts, so that this neck or dry rot is not so common with them. This trouble appears to be clearly different from the smudge fungus which also disfigures the exterior of white onions. The losses are very serious between the gathering of the white onions and time for winter storage while the crates are piled in buildings or in covered ricks in fields.

It appears at this time that the early topping of the white onions, leaving a green neck, offers an inviting way for the disease to enter; that the invasion is in this direction appears from the sclerotia of the fungus which forms in this region. The disease appears to grow worse with continuous cropping of onions and the losses have been so large in storage as to render storage of white onions unprofitable. It has been suggested that the white onions should be gathered and ricked in crates at once, either in buildings or covered with tent or temporary enclosure of building paper, and disinfected or treated with formaldehyde gas. The enclosure should not be opened for 24 to 48 hours after treatment. In this manner it is hoped to keep down the infection of the white onions as well as of any others from similar troubles.

Fig. 1. The Result of Mildew on the Foliage

Fusarium Blight

This is often serious on young onions in old soil and is the forerunner of heavy losses from soft rot in storage.

Heart Rot

Bacterial

This disease appears to come in all varieties of onions, following the topping, by its rapid invasion of the center of the bulb through bacterial infection. It should be controlled by attention to disinfection of the topping machine or to similar treatment to that recommended for dry rot. This disease ends in the complete destruction of the bulbs through a soft rot different from that described under soft rot.

A. D. Selby,
Wooster, Ohio.

Mildew

Peronospora schleideniana

F. D. Bailey

This disease is one that has long been known as a serious disease in England and Europe and other parts of the world as well as in various sections of the United States. It is, without doubt, the most serious and destructive disease of the onion known. It has been reported from various sections of Western Oregon and has been particularly serious during the unusually moist season of 1912. It is found most commonly on beaverdam soils.

Symptoms

The disease attacks the leaves, causing them to collapse (Fig. 1). It usually appears first on a few plants in the field, but spreads rapidly in warm, damp weather. In the first stages of attacks the leaves of an infected plant will show a peculiar violet tint. If these leaves are examined closely this color is found to be due to the presence of a downy growth on the affected surfaces. In a day or two the leaves become weak and gradually collapse. The collapsed leaves dry up and may become covered with black mold, which the grower frequently mistakes for the cause of the trouble. It takes only three to five days from the first appearance of the trouble for the plants to be completely collapsed.

Cause

The disease is caused by a fungus belonging to a group of disease-producing forms commonly referred to as the "downy mildews" on account of the appearance of the fungus on the surface of the diseased parts. It is known technically as *Peronospora schleideniana*. This fungus, like many others, has two spore stages. In the summer stage the spores are formed on branches of the fungus body which appear in great numbers on the surface of affected leaves. It is these spore-bearing structures which cause the downy appearance mentioned above. The spores are spread by the wind and cause new infections. Since the time required for the fungus to kill the leaves is very short, it is readily seen why the disease spreads so rapidly over a field once it becomes started.

Treatment

In those sections where onion mildew is troublesome, the foliage should be kept covered with a fungicide during the growing season to prevent the germination of the spores on the surface of the plant and the consequent infection. The best fungicide for this purpose is Bordeaux mixture. It should be used in the 5-5-50 strength and should be applied at intervals of from ten days to two weeks beginning when the plants show three leaves. Onion foliage is so smooth that Bordeaux prepared in the usual way does not adhere readily. It is necessary, therefore, to add some sticker to the mixture. This sticker is prepared as follows:

Mix together in an iron kettle two pounds of resin, one pound of sal soda crystals, and one gallon of water. Boil in the open air until the mixture is of a clear brown color. This will require about one to two hours.

The above amount is sufficient for 50 gallons of spray.

Literature

1904. New York (Cornell) Experiment Station Bulletin No. 218.

Smudge

Vermicularia circinans Berk.

This fungus develops as a superficial spotting upon the exterior, especially at-

tacking the white varieties; it is really an anthracnose of onions. For some time, because of its coincident development with the black neck or dry rot these two troubles have been confused. It is now apparently clear that there is no connection between the two, although this fungus causes dry rotting of sets and bulbs. The smudge fungus is cumulatively worse on old land where onions are grown consecutively. Apparently also in addition to rotation of crops the formalin drip treatment described under smut gives good results in keeping down this fungus.

A. D. Selby,
Wooster, Ohio.

Onion Smut

Urocystis cepulae Frost

The disease commonly known as onion smut is exceedingly troublesome on many soils that have been planted continuously to onions for a number of years. When this disease once becomes established in the soil it is very difficult to eradicate. Cases have been observed where land infested with smut was not planted to onions for ten years and where the smut reappeared in destructive quantities the first year that the land was again planted. Onion smut is a disease that can be carried with the seed or by cultivators and implements generally, or the spores may be carried by the wind. This disease first makes its appearance in the form of a swelling or hardening of the leaves, usually just above where they unite with the plant. After a time these places burst open and a powdery black dust, the spores of the fungus, emerge and are scattered broadcast. The disease attacks the entire plant and few, if any, good bulbs will be produced by affected plants.

Several remedies are offered for onion smut, none of which has proved entirely satisfactory. Soaking the seed for about twenty minutes in a solution consisting of one ounce of formalin in one gallon of water is recommended for destroying the spores that may adhere to the seeds. This process must be done but a short time before planting and the seed dried by means of plaster; however, the soaking of the seed will render it difficult to plant evenly.

Another method is to fit the seed drill with a small tank and allow a small stream of the above solution to flow into the row just behind the seed dropper and before the seed is covered.

A method frequently used by growers is to provide the seed drills with fertilizer attachments and apply a mixture consisting of 100 pounds of sulphur and 50 pounds of powdered lime in the rows with the seed.

On land that is free from smut precautions should be taken to prevent its introduction. The danger of the spores being present with the seed is not great. The introduction is more often made by throwing diseased bulbs or tops in the manure pile and then hauling the manure on to clean land, or by the dragging of infested soil from one field to another with cultivators and other implements.

Literature

Duggar. Fungus Diseases of Plants.

Soft Rot and Storage Rots

Fusarium sp.

This soft rot is produced by the fungus Fusarium, yet under study. It not only causes an early blight but also invades the onion bulbs quite rapidly after storage infection. The problems of control are essentially those of storage rots, including dry rot.

In onion storage it seems to the writer probable that disinfection of the onions after placing in storage buildings either by sections or otherwise, using the formaldehyde gas treatment, will give excellent and safe results. This needs yet to be worked out.

Stem Rot

This disease causes a rotting of the onion at the juncture of the bulb and stem. The rotting continues after the onions are put into storage. The recommendations are the same as for anthracnose, or black spot.

ONION PESTS

Cantaloup Fly. See *Cantaloup Pests.*

Cut Worm. See *Beet and Cabbage Pests.*

Beet Army Worm. See *Beet Pests.*

Onion Maggot

This small white maggot, which attacks onions is the larva of a fly that

somewhat resembles the common house fly. The eggs are laid on the ground near the plant, or on the stem of the plant. The larvae eat into the onion, and if numerous may do a great deal of damage.

Practice rotation of crops and fall plowing of the ground, with destruction of weeds and all trash where the flies may hibernate. At the first appearance of the maggots, treat the onions with carbolic acid emulsion. Apply thoroughly and enough to soak into the ground around the onions, as the solution must touch the maggots in order to kill them. Make the first two applications five days apart, the others once a week for three or four weeks. The carbolic acid emulsion is made as follows: In one gallon of hot water dissolve one pound of soap; add one pint of crude carbolic acid and churn for ten minutes, or until a creamy emulsion is produced. Then add this to 30 gallons of water and apply as directed above.

Onion Thrips

Thrips tabaci Lindeman

General Appearance

The adult female is pale yellow in color with an elongated dusky spot on the dorsal surface of the middle thoracic segment. The length of the body varies from 1 to 1.2 mm. The eyes are brown, while the antennae and legs are dusky. The wings are faintly yellowish, their fringes being dusky. The antennae are seven jointed. The male larvae are somewhat smaller than the female and of a darker color and often with a greenish tint. The eyes are red.

Food Plants

The onion thrips is especially destructive to onions grown for seed. It damages the seed buds before the seeds have hardened and in many instances causes a complete failure of the seed crop. It is also destructive to roses, carnations and other flowers (wild and cultivated), grasses, fruit blossoms and truck crops.

Control

Nicotine extracts or the Government formula as recommended for pear thrips are efficient control methods for this species. The thrips are most active on the outside of the buds early in the morning, so that is the best time for applying a spray. The flour paste as recommended for the bean thrips is also applicable to this species. E. O. Essig

Western Army Worm. See *Beet Pests*.

Orange

The orange that produces the familiar fruit of commerce is closely allied to the lemon, lime and citron.

Though cultivated widely in most of the warmer parts of the world, and apparently in many completely naturalized, the diffusion of the orange has taken place in comparatively recent historical periods. To ancient Mediterranean agriculture it was unknown; and though later Greeks and Romans were familiar with the citron as an exotic fruit, their "median apple" appears to have been the only form of the citrine genus with which they were acquainted.

The careful researches of Gallesio have proved that India was the country from which the orange spread to Western Asia and eventually to Europe. Oranges are at present found wild in the jungles along the lower mountain slopes of Sylhet, Kumaon, Sikim and other parts of Northern India. The plants are generally thorny and present the other characters of the bitter variety, but occasionally wild oranges occur with the sweet fruit. It is, however, doubtful whether either sub-species is really indigenous to Hindustan, and De Candolle is probably correct in regarding the Burmese peninsula and Southern China as the original home of the orange.

See *California Citrus Industry*, under *California*.

Orange in California

To the mission fathers we owe the first introduction of many of the fruits and vegetables into California. Among the many fruits which they brought with them four stood the test of over a century and came down to modern times. These are the Mission olive, the Mission grape, the Mission fig and the Mission orange. Recently all these except the Mission olive have been replaced with more desirable varieties. All were ex-

ceedingly hardy, and the grape and the fig are still grown and for domestic consumption are still in favor; the Mission orange, however, could not stand before the Navel, the Mediterranean Sweet, the Valencia and other varieties, and after more than a century of popularity it had to give way.

The work done by the mission fathers demonstrated the feasibility of growing the semi-tropical fruits in California, but beyond this nothing was done in this direction for a century, and the great citrus industry which, with a full crop, will now export nearly 50,000 cars of fruit annually, may be said to have risen within the past thirty years. The first commercial shipment was made from the Wolfskill orchard, which was then located in what is now a busy section of Los Angeles. Freights were high, from $1,000 to $1,200 per carload, and while this shipment made good returns to the owner, owing principally to its novelty, the export of oranges was slow and languishing, and ten years after the first shipments had been made the exports had not risen much over 2,000 carloads from the whole state.

The event which transformed the whole situation in California orange growing was the introduction of the Bahia or Washington Navel orange, a description and history of which follows:

*Washington Navel *(Bahia, Riverside Navel)*. Fruit large, solid and heavy; skin smooth and of a very fine texture; very juicy; high flavored, with melting pulp; is practically seedless, only in exceptional cases are seeds found; tree is a good and prolific bearer, medium thorny, a rapid grower, although it does not attain a very large size; bears when very young, commencing to bear as early as one year old from the bud; ripens early. This variety was imported from Bahia, Brazil, in 1870, by Mr. W. Saunders of the Department of Agriculture at Washington, and in 1874 two trees were received from Washington by Mrs. Tibbetts, of Riverside, California. Trees were also received about the same time by Alexander Craw, but the Riverside trees were first to bear fruit, and the excellence of the variety being at once recognized, it was propagated rapidly and took the name of Riverside Navel from the place where its characteristics were first made known. As it came to be known largely in other districts as well, a broader name, Washington Navel, recognizing its receipt from the national capital, was adopted.

There is much tendency to variation in the Washington Navel, and sub-varieties are to be found involving departures in the direction of thinness and silkiness of rind, etc., as well as interior characters. The first to become prominent of these is Thompson's Improved Navel, which A. C. Thompson, of Duarte, Los Angeles county, claimed to have produced by a process of propagation, but which is believed to be a natural variation. It is a very refined fruit, generally held to be too fine for ordinary handling.

* E. J. Wickson in California Fruits.

CITRUS FRUIT GROWING

The growing of the finest citrus fruits is a horticultural accomplishment not surpassed in any line of the art. There are very few agricultural occupations that require an equal amount of judgment, and very few that give as remunerative a return for the mental outlay.

Climate

In general it may be stated that in all regions in which the temperature does not fall below 18 degrees above zero nor rise above 100 degrees F., and where there is sufficient moisture, citrus fruits may be produced. There are, however, localities within these limitations that can not be said to be good citrus-growing sections. In some places, although the trees grow luxuriantly, heavy rainfalls occur at the time when the fruits are maturing, making it impossible to gather and market them. In others the conditions for vegetative growth are so favorable that very little fruit sets. Regions that are excessively dry may, however, be utilized for citrus culture when irrigation can be practiced. The more nearly the northern limit of the citrus belt is approached, the more sprightly and deliciously flavored the fruit becomes, some

of the very best fruit being marketed from areas where the trees every winter are in danger of being frozen out.

Soil

It will be shown under the heading "Varieties" that citrus trees are exceedingly variable, and consequently will readily adapt themselves to almost any kind of soil in which plants can grow.

While the rich, alluvial soils produce citrus trees of rank growth which often bear enormous crops of fruit, the finest and highest-priced fruits are produced upon the nearly sterile soils. In fertile soils the plant food is seldom properly balanced and present in the condition best suited for producing the finest fruits, nor is it possible to influence the contents or quality of the fruit by applying different forms of chemical fertilizers. If, therefore, a field is normally sufficiently fertile to produce a citrus crop for an indefinite number of years, it is usually impossible to influence the quality of fruit markedly by means of fertilizers. Upon soils which are nearly sterile, however, trees may be started and fed with just such chemicals as will produce the finest quality of fruit. It therefore happens that soils which formerly were considered absolutely worthless for agricultural purposes are now made to produce large crops of most excellent fruit.

The variation of the soils in the West Indies and in Louisiana, Mississippi and California is not so sharply marked as that in Florida. There are, however, characteristic soils in each of these regions that are better than others. In all sections a soil must be chosen that is not underlain with a heavy substratum known as "hardpan." The land should be elevated sufficiently to permit free drainage, and, in the sections where irrigation must be practiced, should be so located that water can be easily supplied.

Frost Protection

*After determining that the desirable features specified are to be found in the location under consideration, it is very important to see that the land is well protected from the occasional frosts which visit the citrus-growing sections. Frost protection is imparted by large bodies of water, such as make citrus growing in Louisiana and Mississippi possible, and in Florida near the lakes in the central part of the state, along the Indian river on the east coast, and on Tampa bay. In the West Indies and the southernmost part of Florida this factor does not enter into consideration. In fact, it seems that those places in the West Indies which are subjected to the lowest winter temperature produce citrus fruits of the highest excellence. The temperature in the vicinity of Mandeville, Jamaica, is said to go as low as into the fifties during winter nights, and yet this is probably the best citrus-fruit section on the island.

Protection from High Winds

A location chosen so as to combine all the qualifications already mentioned may still be undesirable if it is exposed to the force of high winds, which may occur in any portion of the country. It is quite impossible to protect a grove against tropical hurricanes, but the more common high winds of annual occurrence must be considered. They carry off the moisture and bring with them a dry, parching air which is injurious to citrus trees, and they are also very likely to cause " thorning" or to mutilate the fruit in other ways. Sometimes it becomes necessary to erect artificial wind-breaks for protecting a grove not well located. These artificial wind-breaks may later be supplanted by some natural growth that can withstand the force of the wind.

Varieties

The group of plants which is designated by the generic term "Citrus" is fairly well circumscribed, but when it comes to a segregation of the different species and varieties scientists do not all agree; the writer has adopted the classification worked out by Dr. Herbert J. Webber in the Cyclopedia of American Horticulture.

* In recent years the practice of "smudging" or heating the orchard in sections where frost is likely to occur has reached a high state of efficiency, and in California, especially, many growers regularly provide for artificial heating. See article on METHODS OF FROST PREVENTION, under *Frost*.—Ed.

Botanical and Horticultural Classes of the Genus Citrus

Botanical species	Botanical varieties	Horticultural races	Horticultural varieties
I. Trifoliata			Trifoliatas
I. Aurantium	Amara		Sour. Bitter sweet. Seville.
	Bergamia		Bergamot orange.
	Sinesis	The common oranges	Bahia. Valencia. Homosassa. Pineapple. (Also other varieties.)
III. Nobilis		The mandarin group	Satsuma. China (mandarin). Dancy (tangerine). Oneco King.
IV. Decumana		Pomelo (grapefruit)	Royal. Pernambuco. Triumph. (Also other varieties.)
		Shaddock	Paradise. Forbidden fruit. (Also other varieties.)
V. Japonica		Kumquats	Nagami. Marumi. (Also other varieties.)
VI. Medica	Genuina	Citron	Corsican. Lyman. Orange. (Also other varieties.)
	Lemon	Lemon	Lisbon. Villa Franca. Sicily. Eureka. (Also other varieties.)
	Acida	Lime	Imperial. Mexican. Persian. (Also other varieties.)

Selecting Varieties

Experience has taught that no variety of citrus is pre-eminently useful for all portions of the world where this fruit is grown. As an illustration we have the Bahia, or Washington Navel orange, which is pre-eminently adapted for California, but of little value in Florida or the West Indies, since it produces only a small crop except on rough-lemon stock, which stock is only adapted to a restricted area. Certain varieties of pomelo have exquisite flavor when fruited in Florida, but are not of the same excellence when grown in California. The Pineapple orange and the Indian River orange are among the finest of fruits when grown in the sections where they originated, but when produced in Jamaica they can not be said to have superior qualities.

The total number of varieties of citrus fruits that have been catalogued and described would run up into the thousands. Nearly every one has some peculiar merit for a particular locality. Out of the many thousands a few selected ones are of general value, and can be planted with safety over a considerable area. The following very brief list gives some of the varieties for the localities mentioned:

Florida

The Florida State Horticultural Society has divided the state into four horticultural sections known as Western North Florida, Eastern North Florida, Central Florida and South Florida.

Eastern North Florida includes "that part of the state between the Aucilla river and a straight line drawn across the state from the mouth of the St. Johns river to Cedar keys."

The following citrus fruits are considered especially adapted for this region: Of the sweet-orange group, Parson Brown and Sweet Seville; of the tangerine group, the Satsuma; of the kumquat group, the Marumi and Nagami.

Central Florida includes "that part of

the state between the line above referred to and the counties constituting South Florida."

Of the sweet-orange group well adapted to this section may be mentioned Centennial, Tardiff, Homosassa, Jaffa, Majorca, and Parson Brown; of the mandarin group, Satsuma, China, Dancy and King; of the pomelo group, De Soto, Duncan, Excelsior, Hall, Marsh, Pernambuco, Royal, and Standard. Shaddocks and citrons are not grown as commercial fruits, and Nagami is the leading variety of kumquat for this section.

South Florida includes the following counties: Brevard, Dade, Monroe, De Soto, and Manitee.

The sweet oranges recommended for this section are the Bahia on rough-lemon stock, Tardiff, Homosassa, and Majorca; of the mandarin group, China, Dancy, and King; of the pomelo group, De Soto, Duncan, Excelsior, Hall, Marsh, Pernambuco, Royal, and Standard.

Shaddocks are not grown commercially, and are found only as ornamentals or novelties. In the kumquat group the leading variety is the Nagami. Citrons are grown only as occasional specimens.

Lemons are not grown as extensively in Florida as in California. There are, however, some good orchards of this fruit, the varieties principally produced in South Florida being Belair, Genoa, Imperial, Sicily, and Villa Franca.

On the keys and the adjacent coast considerable quantities of limes grow without cultivation and are apparently naturalized. The Department of Agriculture has distributed various importations of limes into South Florida, and nearly all of these varieties do very well. The peculiar demands of the market, however, are such as to make lime growing unprofitable. Nevertheless, very high prices are paid for the limes which are gathered from trees occurring spontaneously on the coast and keys. This lime is generally spoken of as the Key lime. It is a very small fruit and intensely acid, and usually contains many seeds. This same lime when taken to the mainland and put under cultivation produces a large fruit, with very thick, rough skin, approaching in size and appearance that of the usual lemon. Limes of this size do not meet with ready sale.

Louisiana and Mississippi

The citrus-growing section of Louisiana and Mississippi occurs in the region closely bordering on the Gulf. In Mississippi it is near Biloxi, and in Louisiana it is south of New Orleans.

In these sections the common sweet orange grown is known as the Creole. This, strictly speaking, is not a variety, but an assemblage of seedling oranges that have been cultivated in this region for some time. Of the mandarin group Satsuma and China are the leading varieties. Of the pomelo group only a few are grown, these being the earliest varieties, such as Royal and Triumph.

Porto Rico and the West Indies Generally

Citrus growing throughout the West Indies is in a rather formative state. The efforts at systematic work in this line have not been carried forward with the same degree of vigor as in California and Florida. Nearly all the varieties recommended for South Florida may be planted with more or less confidence in this region. After years of experimenting in this region local varieties will doubtless develop which will prove better than some of the sorts now introduced on these islands.

GROWING AND MARKETING

Setting Out

Usually the prospective orange grower buys trees from a nursery and sets them out as soon as the field has been cleared, wishing, of course, to get the trees on the land as soon as possible and to hasten the time when he may be selling fruit. Sometimes this is by no means the most profitable procedure. Land especially rich in organic matter and heavily matted with roots from the native growth would be decidedly better for having produced a crop or two of vegetables before the grove was planted. If for any reason it is not desirable to grow vegetables, a crop of weeds grown on it for a year would do much to

sweeten the land preparatory to receiving the trees from the nursery. A crop of cow peas or velvet beans would be preferable, however.

The number of trees to be set out to the acre depends on the variety selected and the character of the land. Large-growing citrus trees, such as pomelos and the Bahia and Tardiff sweet oranges, should not be set closer than 100 to the acre, and on first-class soil 75 are enough. Smaller-growing varieties, such as the mandarin group of oranges and the limes, should not be set closer than 200 trees to the acre. The character of the land will also need to be considered in setting out a grove. In a sandy loam rich in organic matter trees grow much more vigorously and in consequence should be set farther apart. In the heavy clay soils trees grow less vigorously and may be set nearer together.

Time and Manner of Setting Out

The time of setting out trees from the nursery will depend on the location and the conditions. In the West Indies and South Florida trees may be set out at any time of the year when the land is ready and there is sufficient moisture to favor their growth. In Central Florida, the spring (February and March) is preferable. The same is true of North Florida, Louisiana and Mississippi. In the extreme northern portions of the citrus-growing section it is usually better to wait until the danger of freezing weather is past. This will bring the date up to about the latter part of February. In setting out trees from the nursery, care should be taken to injure the roots as little as possible. Where trees can be taken up with a considerable ball of earth and transplanted in this way, they may be set out without any apparent check in growth. This, however, is not usually practicable in sandy soils.

When the trees are taken up the roots should be carefully protected by means of wet cloths or moist moss and the trees set in holes already prepared for them. If the ground is not already very moist the addition of one or two pails of water will usually puddle the roots and cause the trees to grow promptly. At the time of setting out, the tops should be cut back to correspond closely to the condition of the roots. The favorite size of tree to set out is one that has grown about four feet tall in the nursery and has several branches. Such trees are usually about an inch or an inch and a half in diameter at the crown.

Catch Crops

As soon as the field has been set to a grove, cultivation may be begun. The kind and amount of cultivation will be determined by the character of the soil. Light, sandy soil should have shallow but careful cultivation. Heavy clay soils need thorough and deep working. Where there is an abundance of moisture supplied naturally to the soil, other crops may be grown to advantage between the orange trees. Where the soil is inclined to be dry and irrigation has to be practiced, this is of doubtful utility in the dry season. During the winter, vegetables may be planted and cultivated as in ordinary fields with decided advantage to the orange tree unless the land is too dry. Leguminous cover crops may be planted as soon as the spring and summer rains begin. When fall droughts occur the cover crops will have to be removed to conserve the moisture of the soil. Cultivation should then be resumed. If the soil is inclined to be sterile the cover crop should be used as a mulch for the trees. If the ground is sufficiently fertile to permit it, the cover crop can be utilized for hay.

Pruning

"To prune or not to prune; that is the question." At many of the meetings of the horticultural societies the question of pruning has been vigorously discussed. There are many good reasons for pruning trees; on the other hand, there are reasons why trees should not be pruned. The question, then, must be decided by each individual. One point, however, has been very well settled, and that is, that low-headed trees are preferable. Twenty-five or 30 years ago it was a common practice to have citrus trees trimmed high

enough to permit a man to drive a cultivator under the branches. The severe cold of several winters has caused this custom to be very largely abandoned. In the southern part of Florida, where there is no danger from frost, it has been found that shading the ground by the limbs has been very beneficial to the grove. Another important advantage in low-headed trees is that the fruit may be gathered much more cheaply than from tall trees.

Nearly all orange growers will agree that the pruning out of dead and worthless branches is of benefit to the tree. The extent to which sound wood is pruned out, however, varies with the notions of the individual grower. Some of the most extensive and best growers in Florida practice no pruning at all. Diseased branches should always be cut out, removed from the orchard at once and burned. Sprouts that start from below the bud must be removed, and this should be done as soon as possible. Water sprouts need not and ordinarily should not be removed. There are conditions under which removal is entirely proper, but the very common practice of removing them simply as a pastime is a very harmful occupation. The fact that a water sprout appears shows that the tree is in a position to elaborate more reserve material than can be elaborated by its present leaf area. After a year or two years these water sprouts produce an abundant crop.

A citrus tree should be kept in a low, compact form, but violent pruning, such as is often practiced in deciduous fruit orchards, is not only unnecessary but often harmful. There are special cases, such as lemon orchards, and there are some regions in which trees must be mutilated to make them fruit; but that does not affect the general rule that citrus trees should be sparingly pruned or not at all.

Picking

In citrus growing, as in the growing of other commercial products, the agriculturist frequently does everything perfectly up to the time of harvesting his crop. He then gets in a hurry, and as a result of overhaste his product goes into the market in bad condition. This is especially to be regretted since so frequently his fruit is fautless when the time for picking arrives.

In picking citrus fruits the greatest care should be exercised not to include any imperfect specimens. The fruits should be separated from the tree by means of a clipper, cutting the stem off close to the fruit, leaving it smooth, so that when another fruit comes in contact with the cut stem it will not be injured thereby. The picked fruit should be placed in some sort of basket. Frequently the fruit is picked in sacks. While thousands of crates are picked in this way, and the fruit is marketed in fairly good condition, first-class oranges in the prime of condition are apt to be either scratched or slightly bruised. Thoroughly ripe fruit is so filled with juice that it will spurt out if a thorn or the point of a knife blade be stuck through the skin. It must be taken to the packing house with the greatest care and permitted to cure before it is fit to pack. When the picker has secured as much fruit as can be conveniently put in a basket, it is turned into a field crate. These crates are usually of slightly larger size than the shipping crate, and so constructed as to make it possible to nest them for transportation to the packing house. After the fruit has been picked for some time and the skin has toughened and the fruit has been permitted to shrink to some extent, it may be handled with much less danger of being injured. This usually requires from three days to two weeks. At the end of this time the fruit is graded according to its appearance. This grading has to be done by hand, and requires the judgment of a man skilled in citrus sorting. Various names are given to the grades of oranges, such as brights, fancies, seconds, golden russets, russets, dark russets, and so on. Usually there are about three grades in a grove, the brights, golden russets, and russets. The brights are divided into fancies and seconds.

Lemons are picked while the color is

green, the time of picking being governed by the size attained by the fruit. After picking it requires from one to several weeks to cure them properly for market. This is usually done in specially constructed houses, in tents, or in banks.

Washing

Citrus fruit grown on a tree free from disease and insect attack is usually in the most perfect condition possible. Its appearance can not be improved by washing or other mechanical process. But a very large proportion is not grown under such conditions. Russet fruit is not improved in appearance by washing or scouring, but fruit affected by sooty mold should be put through a washer. Sooty mold is a black fungus (*Meliola*, various species) that grows in honey dew, usually excreted by some insect. An insect that frequently produces the honey dew is the white fly (*Aleyrodes citri*). Sooty mold very frequently follows an attack of the soft scale (*Lecanium* sp.), but this insect is usually very limited in distribution as compared with the white fly. The coloration of sooty mold being due to a fungous growth on the surface of the fruit, it becomes necessary to use some mechanical means for removing it. Various machines have been invented for accomplishing this purpose. One in very general use has a series of brushes, slightly larger than scrubbing brushes, arranged on a chain belt. The fruit is received in single file down a chute, at the bottom of which is water in which the fruit is washed. The water and the brushes cause a very decided improvement in the color of the fruit.

Another form of cleaner is constructed from a cylinder about two feet in diameter and about four feet long. An axle in the form of a gas pipe is run through the axis of the cylinder, a crank is attached to this, and the cylinder is then mounted on a frame so that it can be revolved by hand. The inside of the cylinder is carefully padded with canvas. Fruit is placed within the cylinder until it is about three-fourths full, the remaining space is then filled with wet sawdust. By revolving the cylinder the wet sawdust wears off the sooty mold very quickly. When the fruit has been cleaned it is turned out and dried and is ready to be packed. The sawdust used for this work must be as soft as possible and must be sifted to free it from any large particles that might scratch the rind of the fruit.

Sorting

After the fruit has been graded, it is run through a machine which separates it according to size. Various kinds of apparatus are constructed for this work. One of the simplest is that made in the shape of a hopper with a chute running from it. This chute gradually increases in size, so that the fruits as they roll down drop into secondary chutes, which carry them into the field boxes from which they are taken to be wrapped. Lemons are usually picked when they have reached the desired size, which renders sorting for size unnecessary.

Another machine makes a very satisfactory apparatus for sorting both oranges and pomelos. It is run by a treadle. The fruit is poured into the broad chute and is allowed to run into two grooves. On the sides of these grooves, or runways, are long, thin cylinders provided with spirals. The runways as they pass away from the hopper widen, which permits the fruit to fall through when the proper width is reached. The cylinders provided with spirals revolve so as to carry the fruit forward. On each side and in front are compartments for receiving fruit of each size.

Wrapping

The usual way of wrapping is by hand. This has been superseded in the larger packing houses by machines. The taste and care displayed in preparing the wrapping paper have frequently yielded good returns. In the large establishments wrapping paper having a suitable advertisement upon it, and often with a monogram or some other pleasing design, is used.

Packing

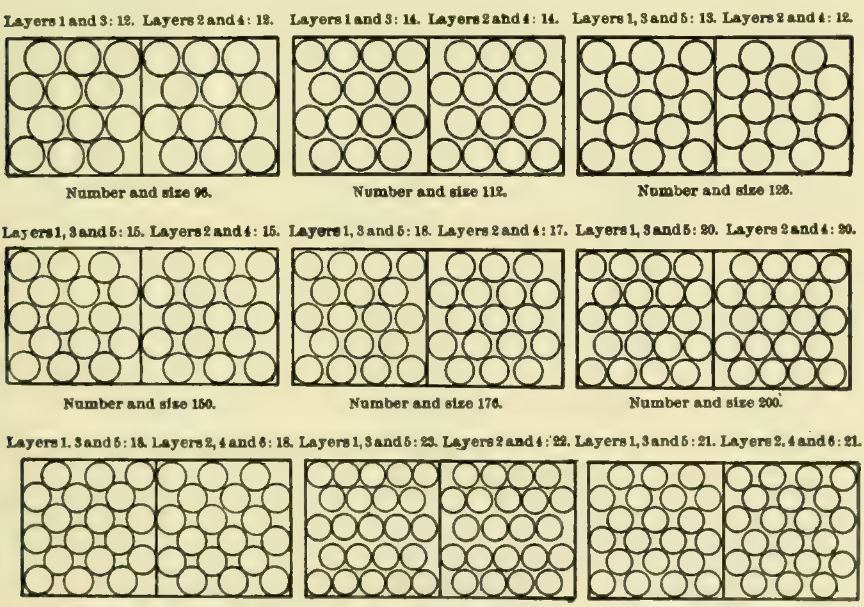
The packing may be done either by hand or by machinery. The greater quantity is packed by hand. The number of

fruits and their arrangement in the box have been carefully worked out so that each fruit is placed in mathematical order. The orange and grapefruit crates commonly used contain a space of almost exactly two cubic feet. The outside measurements approximate 12½x12½x27 inches. As these crates are manufactured and sold to the grower all ready to nail up, he need give this matter no special attention. In packing, the boxes are usually filled so that the last tier of fruit projects about one-half inch above the top of the box. After the box has been carefully packed, it is placed under a lever or screw press and the lid gently forced into position. This is then nailed down and strapped, and is ready to be stenciled for the market. The accompanying diagrams, from Prof. H. H. Hume's Bulletin No. 63 of the Florida Agricultural Experiment Station, illustrate the arrangement of the fruit in the crates.

Shipping

The moment the fruit is delivered to the transportation companies it passes out of the hands of the grower and beyond the possibility of his controlling the way in which it is handled. Not infrequently fruit put up in the very best condition, and with the greatest care, is slammed from the railway station into the car, and at its destination is again thrown from the car into a transfer wagon. Anyone wishing to be convinced on this point has only to follow his shipment past the transfer station and to its destination on the market. The most careful packing and best packages are none too good. To a certain extent the shipper of fruit is powerless in this matter, and very frequently the transportation company's officials are ignorant of the rough handling.

The only way to correct these abuses is by vigorous protest and definite action. All transportation companies are sufficiently interested in the matter to see in



Diagrams showing the arrangement of oranges of different sizes in crates: No. 96.—Diameter, $3\frac{1}{2}$ inches; layers, 4. No. 112.—Diameter, $3\frac{1}{4}$ inches; layers, 4. No. 126.—Diameter, $3\frac{1}{8}$ inches; layers, 5. No. 150.—Diameter, $3\frac{1}{16}$ inches; layers, 5. No. 176.—Diameter, $2\frac{13}{16}$ inches; layers, 5. No. 200.—Diameter, $2\frac{11}{16}$ inches; layers, 5. No. 216.—Diameter, $2\frac{11}{16}$ inches; layers, 6. No. 226.—Diameter, $2\frac{9}{16}$ inches; layers, 5. No. 252.—Diameter, $2\frac{7}{16}$ inches; layers, 6.

a general way that the fruit is handled with a certain degree of care, but as long as no strong protest is made they take it for granted that everything is satisfactory. No matter how carefully and exactly the fruit is packed, if the packages are abused in transit the results must be disappointing.

Storing

A great many attempts have been made to store citrus fruits. With the exception of the lemon, storage is not thoroughly successful unless the fruit is put in cold storage. Various methods have been suggested, such as packing the fruit in Florida moss, packing it in dry road sand, storing it in caves, etc. The results of experiments with all of these, however, have been disappointing.

In general it may be said that citrus fruits may be stored in a cool, dry place for two or three months without danger of serious loss. The temperature should not fall to the freezing point, and should not go much above 40 degrees F. The air should also be dry enough to prevent moisture from forming on the fruit or packages during fluctuations in temperature.

In cold storage very fair success has been obtained in keeping the fruit, and when full information shall be at hand it will doubtless be possible to keep citrus fruits, at least in limited quantities, until the new crop comes in.

Marketing

The market selected for selling the fruit will vary with individual growers, the price being fixed by that obtained in the large markets, such as Chicago and New York. The price at the groves will be largely determined by the quantity of fruit supplied.

Where the fruit is sold on the trees, a definite written contract should be made, so that there is a full understanding as to the price to be paid for it, a date agreed upon at which all the fruit must be removed from the grove, and provision made for responsibility for injury to trees. The owner of the grove must expect to suffer more or less in the way of broken trees and limbs if the fruit is sold on the tree. Any unusual damage done to the trees, either by draft animals or by careless workers, should, of course, be borne by the person who buys the fruit and must be provided for in the contract.

A more satisfactory way of selling the fruit is at a definite price per box of a certain grade and size, delivered at the shipping station in first-class condition.

Usually the owners of small groves can not dispose of their fruit in the grove, but very frequently are able to sell it for a definite price at the shipping station. When the fruit is sold in this way, it is but fair and prudent to have a written contract giving full particulars as to prices, grades, sizes and conditions. While much fruit is sold in this way, the great bulk of the fruit is shipped to the large markets to be sold. In such a case the grower should know to whom the fruit is consigned, having learned beforehand whether the sellers are responsible or not. While the determination of the financial responsibility of commission merchants or fruit handlers may seem difficult to the average grower, it is really a very simple matter to learn whether a business firm has any good references or not. If the persons mentioned as references are addressed and no word is heard from them, it will be the safest course to assume that the reply would have been unfavorable.

P. H. Rolfs,
Pathologist, U. S. Department of Agriculture.

VARIETIES

District No. 6

Highly recommended — *Dessert and Market:* Bessie; Centennial; Enterprise *Seedling;* Foster; Hart *Late (Hart's Tardiff)*; Homosassa; Imperial *Blood;* Jaffa; Jaffa Blood; Majorca; Maltese Egg; Maltese Oval; May's Best; Nonpareil; Old Vini; Parson *Brown;* Pineapple; Ruby; Valencia *Late;* Vinous, *Madam. Dessert and Kitchen:* Phillips Bitter *Sweet.*

Recommended — *Dessert and Market:* Acapulco; Acis; Amory *Blood;* Bahia *(Washington Navel);* Beach *No. 5;* Boone; Botelha; Brazilian; Buttercourt;

China; Circassian; Colmar; Cunningham; Drake *Star;* Double *Navel;* Dulcissima; Dummit; Du Roi; Early Oblong; Exquisite; Fortuna; Higley *Late;* Lamb *Summer;* Magnum Bonum; Maltese Blood; Mediterranean *Sweet;* Melitensis *Navel;* Paper Rind *St. Michael;* Peerless; St. Michael; St. Michael Blood; Star Calyx; Whittaker. *Dessert and Kitchen:* Bitter Sweet. *Kitchen:* Dwarf; Sour.

RECOMMENDED FOR TRIAL—*Dessert and Market:* Long; Prolific; Saul *Blood;* Seville *Sweet;* White.

District No. 16

RECOMMENDED — *Dessert and Market:* Bahia *(Washington Navel).*

RECOMMENDED FOR TRIAL—*Desscrt and Market:* Mediterranean *Sweet.*

District No. 17

HIGHLY RECOMMENDED — *Dessert and Market:* Bahia *(Washington Navel).*

RECOMMENDED — *Dessert and Market:* Mediterranean *Sweet;* Parson *Brown;* St. Michael; Thompson *Improved.*

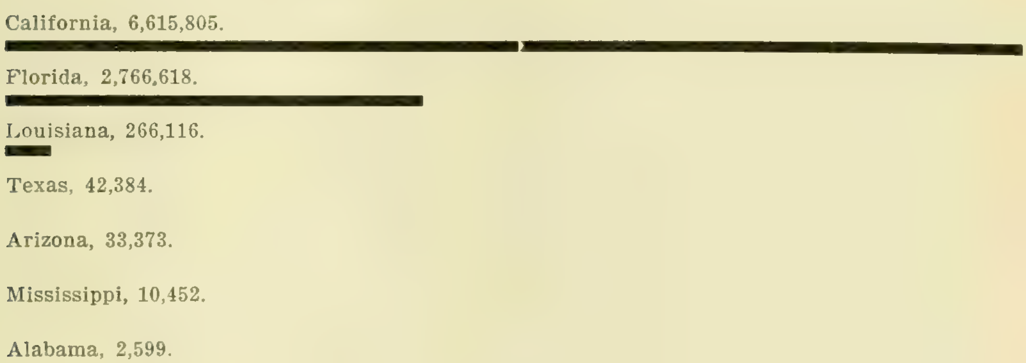
District No. 18

HIGHLY RECOMMENDED — *Dessert and Market:* Bahia *(Washington Navel);* Mediterranean *Sweet;* St. Michael; Thompson *Improved;* Valencia *Late.*

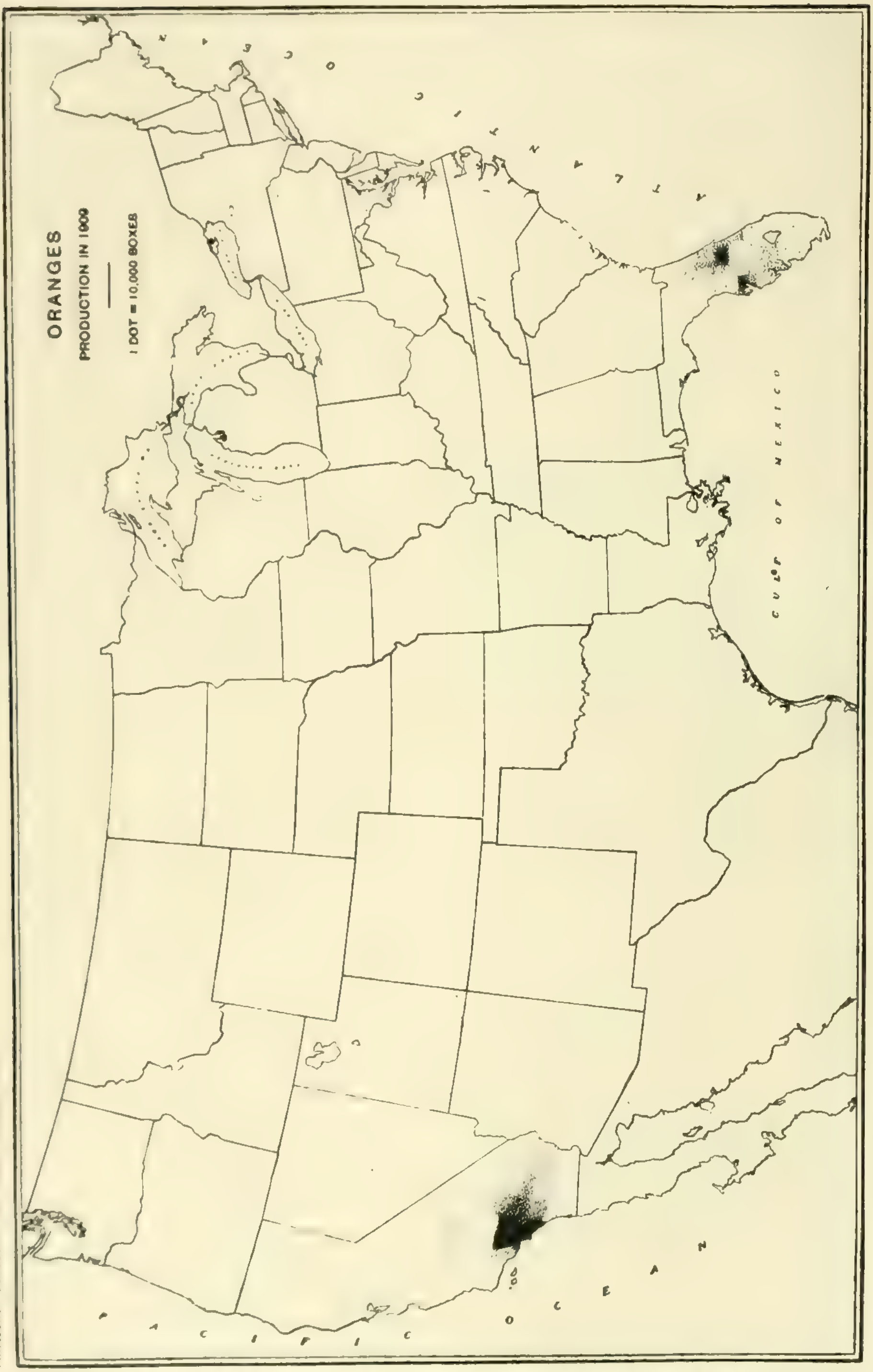
RECOMMENDED — *Dessert and Market:* Maltese *Blood;* Parson *Brown;* Ruby.

Oranges in the United States

There are but few states in the Union where oranges can be grown successfully for commercial purposes. The following are the states with the number of bearing trees, as reported by the census of 1910.



Department of Commerce, Bureau of the Census.



Thirteenth Census of the United States. 1910.

Map Showing the Location of the Orange Industry in the United States

ORANGE DISEASES

ANTHRACNOSE. See *Wither Tip*, this section.

BLACK ROT. See *Navel Rot*.

Blue Mold

Penicillium italicum and *P. digitatum*

The fruit shows a soft moldy decay, the surface of the affected portion being covered with a dusty mass of spores, of a blue or green color, according as the first or second named fungus is present. The blue fungus is somewhat more active than the green and causes occasional infection by contact from one fruit to another.

The two fungi named above are the commonest cause of decay in citrus fruit. Only very slightly parasitic on uninjured fruit; this decay is practically confined, under ordinary conditions, to fruit which has been injured in handling.

The extensive demonstrations of the United States Department of Agriculture have established beyond question that citrus fruit will keep indefinitely so far as blue-mold decay is concerned, unless the fruit has been bruised or injured in some manner. Such injury comes about mainly either through cuts in the stem end made in clipping the fruit from the tree, from rough handling during the process of hauling to the packing house, or in grading or packing. As a result of the demonstration mentioned above, the whole practice of citrus-fruit handling has been revolutionized along the line of more careful handling, and implements and apparatus tending toward less injury in picking and handling fruit have been developed. Each year's experience goes more and more to demonstrate the possibilities of almost prevention of this commonest form of decay through careful handling.

Brown Rot of the Lemon

Pythuacystus citrophthora R. E. Smith

Occurrence

The brown rot of the lemon is a disease which has become very prominent in the region of lemon production in California during the past few years. It affects more or less every operation having to do with lemon production and marketing, and at the time of the investigations which were undertaken in California for its control it seemed to threaten the stability of this industry. The brown rot may be found in the orchard, in the packing house, and in storage conditions.

Symptoms

The first indications of the trouble may be noted in a brownish or purplish discoloration of the rind, showing light on the greener fruit and darker on the yellow fruit. Both old and young, vigorous and weak fruits alike are affected, and the disease is particularly characterized by a marked and peculiar odor, by its rapid spread from fruit to fruit, in the packing house or while stored in boxes, and by the presence of small flies wherever the affected fruit is stored in quantity. After storage for a week or ten days there may develop upon the affected fruit a white mold-like growth, and frequently upon such affected fruit there is subsequently produced also the blue mold *Penicillium*. The blue mold alone, however, does not spread rapidly and has not the peculiar odor of the brown-rot disease. The disease may appear upon fruit in storage, which seemed to be perfectly colored and sound when passed by the washer.

Control

The infection of the fruit usually takes place in the orchards, and also subsequently by direct contact and also by the operation of washing. It has been found, for instance, that if uninfected lemons are dipped in water in which diseased ones have been washed, infection will in time result on the healthy ones. In fact, the ordinary wash water may itself contain a large number of germs of this fungus, and it may also live more or less permanently in the machine used for washing such fruit. The remedy, therefore, for such conditions is very simple and merely consists in treating the water used for washing purposes with some aseptic or toxic agent. The most practical method which has been devised consists in using copper sulphate, formalin, or potassium permanganate. In using for-

malin, one part of the reagent to 10,000 parts of water may be employed, or one pint to 1,250 gallons has been sufficient to check infection. Permanganate of potash is rather a mild disinfectant as compared with formalin and it is necessary to use one pound to 625 gallons of water. A stronger concentration discolors slightly and the former strength is advised. Copper sulphate, which is both a cheap and effective disinfectant, may be used, of about the same strength as the permanganate of potash. Care should be taken that this is not employed in very much more concentrated form, one pound to 250 gallons, for instance, resulting in injury in the form of a burn. Unfortunately, however, this substance attacks the arm of the tank and is therefore less desirable than those previously referred to. A higher concentration of blue stone is needed on account of the alkalinity of the water used. In distilled water, one part of blue stone to 1,000,000 will be effective.

Brown Spot

A serious trouble in some localities, characterized by the development of dark brown, sunken, dead spots of considerable size on the rind, appearing from five to ten days after the fruit is picked. Not visible on the tree. Apparently due to climatic or other local conditions rather than to any parasite.

It would appear that in the physiological processes which go on in the rind during its development and ripening, some substance or principle is present in certain areas which inhibits these normal processes. When the orange is picked early in the season it appears that this inhibiting substance is in an active condition and causes the area of tissue where it is present to begin to die as soon as the fruit leaves the tree. If the orange stays on the tree until later in the season the injurious substance seems to disappear or be removed in some manner, leaving the rind in a normal condition.

Chlorosis

This term applies to cases where the leaves become yellow and pale, lacking the normal green color. No definite disease is indicated by these symptoms, more than that the trees are in distress of some sort. The cause of the trouble is usually to be found in some unfavorable soil condition.

Damping Off

Rhizoctonia fusarium

Causes the loss of great quantities of orange seedlings in the seed beds. The plants begin to die in spots which gradually extend, finally involving large areas if not checked. Two distinct forms of the disease are recognizable, one caused by the first-named fungus above, producing a decay of the stem just above ground, while the other shows itself in dead spots on the stem at any point.

These troubles can only be controlled by strict attention to proper methods of planting and watering. The seed bed should be constructed with an inch of clean, fresh sand on top, with heavier soil beneath. For the inexperienced grower, particularly, it is better to make furrows six inches deep and about a foot apart, planting the seed broadcast on the ridges between. The water may then be run in these furrows and allowed to soak into the ground laterally, rather than being sprinkled on the surface. Where the seed is sown broadcast all over the surface of the bed and the water applied by sprinkling, watering should always be done in the morning and no oftener than is absolutely necessary. In many cases a good watering once a week is sufficient to keep the soil under the sand wet enough and twice a week is almost always sufficient until the plants get quite large. It is better to give the bed a good soaking at long intervals rather than to keep sprinkling on a little water frequently. One should keep the surface as dry as possible and after the plants get well started determine the need of water by digging down into the soil beneath rather than wetting the bed as soon as the surface sand gets dry.

Die Back

This general term denotes cases where the branches die back from the tips. It is not a specific disease, but as in the case of mottled leaf, indicates that something is wrong with the tree. The trouble

usually lies underground, and most often denotes unfavorable soil conditions or lack of water.

Exanthema, Florida Die Back

The branches die back from the ends and numerous axillary buds develop, forming bushy tufts of small twigs all through the top of the tree. Corky outgrowths develop on the bark of the twigs and gum exudes from these places. In the first stages of the disease there develop near the center of the tree abnormally large, dark-green leaves, giving the tree a false appearance of unusual thrift. The fruit takes on a pale-yellow color while still small and immature and has an insipid sweetness with no development of acid quality. Dark-brown spots or patches appear on the rind and from these as centers the oranges crack and split.

This disease occurs in California mostly upon coarse or gravelly soils or subsoils, following the application of stable manure or other nitrogenous material in an organic form. It is most apt to occur when such fertilization is practiced on trees which have not previously been receiving it, especially if they have been suffering somewhat from lack of plant food and water. The disease may be likened to a form of indigestion.

On these soils citrus trees should receive very careful irrigation to the end that the ground may be kept continuously moist and not be allowed to become alternately dry and wet, as is the tendency on such porous soils. Fertilization should be uniform without the sudden application of large amounts of manure or organic fertilizers.

Florida Die Back. See *Exanthema*, this section.

Gum-Spot Leaf Spot

Dark colored, slightly raised spots or areas appear on the back side of the leaf in places where it is turned up and exposed to the sun. These spots are formed by the deposition of a gummy substance in the tissue. The trouble appears to be in a form of gumming resulting from sunburn on the under side of the leaf. Not serious.

Mal di Gomma

A virulent decay of the bark of the roots from the surface of the ground downward. This is occasionally found on trees in extremely heavy wet soil or where too much water is used close about the trunk of the tree.

Affected trees can rarely be saved but may be replaced successfully if soil conditions can be improved.

Mottled Leaf

What has been said in the last case applies to this also. Affected trees show a yellowing of the leaves between the veins, with the green color only along the mid-rib and the lateral veins, giving the leaf a mottled appearance. Examination shows that leaves once green never become typically mottled thereafter, although they may become lighter in color or even bright yellow. Typical mottled leaves are found only toward the ends of the shoots and represent leaves in which the green color has never completely developed, rather than those in which the chlorophyll has once existed but then disappeared. Mottled leaf is a case of non-development or slow development of chlorophyll. Along with the mottling of the leaves there also occurs, if the trees are badly affected, a decided shortage in the amount of fruit, and in typically bad cases the fruit present is of very small size, becoming fully colored when only an inch or two in diameter. Considerable die back also occurs and the foliage is thin and weak, giving the tree a brushy look, with many small, dead twigs at the extremities.

All observations point to one conclusion, namely, that the most prevalent and typical form of mottled leaf is due to an irregular supply of moisture and plant food.

Nailhead Rust. See *Scaly Bark*, this section.

Navel Rot—Black Rot

Alternaria citri

Affected oranges color prematurely in the fall and are affected with a dry, black rot in the tissue below the navel end. This rot is not very virulent and often remains confined to one section of the

orange. Occasionally in seasons of considerable early rain this trouble becomes quite abundant, but it is not usually a serious matter.

Puffing

Characterized by a condition of the rind indicated by the above name. The surface of the fruit becomes rough and uneven, due to a spongy condition of the rind. The whole orange becomes soft and structureless with an unnatural sweetness.

This trouble varies with the season and appears to be connected with soil moisture conditions.

Root Rot. See *Apple Diseases*.

Scaly Bark or Nailhead Rust

Characterized by the appearance of scaly areas of bark on the trunk or branches, the outer bark rising in scales from the inner. Small drops of gum exude in spots on the affected portion, which gradually spreads. Affected limbs die back slowly but new growth keeps taking their place and the tree lives for many years in an unhealthy condition.

This trouble apparently originates in an irregular moisture condition of the soil.

The worst affected trees can not be saved, but should be dug out and replaced. Trees where the disease exists only on the branches will recover if affected parts are cut off. In case the scaly bark is on the trunk and the patch is not too large the diseased portion should be cut out to healthy bark and the wound painted over. Such cases will almost invariably heal completely.

If the trunk is badly affected, but the tree in fairly good condition, the scaly surface bark should be scraped off and several slits cut through the affected area. The scaly part may then be painted over with pure neatsfoot oil, linseed oil, 10 per cent caustic soda or potash solution, or kerosene oil.

The soil about the tree should be thoroughly dug up and the application of oil or whatever is used repeated about once a month for several months. This disease, as well as the last, is not contagious and no infection need be feared to neighboring trees.

Shoulder Spot—Stem-End Spot

A dry, brown, dead spot or area develops upon the orange about the stem end or at one side of the latter on the "shoulder" of the fruit. These spots are primarily dry and not of the nature of decay, but they often become infected with blue mold or other fungi. Often, too, they are covered with a growth of a *Cladosporium* fungus, which forms an almost black mold upon the surface. These spots may also become infected with the wither-tip fungus. This form of spot or deterioration at the stem end of the orange occurs only in old fruit, most commonly in the last Washington Navels of the season. It is especially abundant in seasons following years of exceptional drouth, particularly when the fall rains are very late in commencing. The normal deterioration of the orange when its physiological life is ended begins at the stem end and the present trouble appears to be simply a somewhat premature death of the tissue, owing to the age and weakness of the fruit. This is made more pronounced, as has just been suggested, by a long, dry season during the preceding fall, which weakens the tree and thus reduces the vitality and length of life of the fruit.

Splitting

The fruit cracks and splits on the tree before maturity. Varies from year to year in abundance. Apparently caused by climatic or seasonal conditions causing irregularity in the growth of the fruit.

Stain

A discolored, darkened condition of the rind developing after the fruit has been picked. Occurrence apparently confined to fruit which has been subjected to low temperatures, either in transit or cold storage.

Stem-End Spot. See *Shoulder Spot*, this section.

Tear Stain. See *Wither Tip*, this section.

Trunk Rot

Schizophyllum commune

The trunk or large limbs decay at points where they have been cut off or injured, with the production of small, white, bracket toadstools upon the surface. Not parasitic on sound trees. This also affects apples, walnuts and other trees.

Cover all large cuts or wounds thoroughly with grafting wax.

Wither Tip—Anthracnose—Tear Stain

The wither-tip fungus occurs abundantly upon dead or injured twigs, leaves or trees, but is of doubtful occurrence as a true parasite. This fungus occasionally causes a decay of the fruit of the orange quite different from anything seen in the lemon. The wither-tip rot of the orange consists in a large, rather dry brown spot, starting sometimes on fruit while on the tree during wet weather, and gradually spreading. These spots usually develop at places where oranges touch each other. The same spotting and decay are quite frequently found to a considerable extent in oranges held in cold storage, particularly if the temperature is a little too low. Under such conditions this fungus may develop abundantly and cause a considerable amount of decay.

R. E. Smith.

California Experiment Station Bulletin 218.

ORANGE PESTS

Aphids. See *General Article on Aphids.*

Barnacle Scale

Ceroplastes cirripediformis Comst.

General Appearance

This wax scale greatly resembles the Florida wax scale in shape. The body is dark red or brown, and the white waxy covering is mottled with shades of gray. There is a spine-like projection at the posterior end of the body, which is hid by the wax. The length is one-fifth of an inch; width one-sixth of an inch; height the same as the width. This species is larger and particularly higher than the Florida wax scale.

Distribution

Principally in greenhouses.

Food Plants

Citrus trees, quince, myrtle, persimmon.

Control

Same as for Florida wax scale.

E. O. Essig

Black Citrus Louse

Toxoptera aurantiae Koch

General Appearance

A small dull-black louse, scarcely over 1.5 mm. in length. The apterous forms often appear brown, while the young are a decided reddish-brown to black. Some of the adults are shiny black and have been mistaken for the black peach aphis *(Aphis persicae-niger)*. It is easy to distinguish the winged individuals of this species by the very dark and prominent stigma and the single branching of the third discoidal vein.

Life History

This species may be found in the citrus groves throughout the entire year, all stages being present. The greatest numbers occur during the spring months, when all the new growth may be destroyed on the young trees by them. Older trees are also attacked. The presence of the insects on the larger and older leaves is easily told by their curled appearance, a condition produced by the lice.

Distribution

Throughout the entire citrus-growing section of California. Especially abundant in the southern coast counties.

Food Plants

All species of citrus trees, camellia, *Olea straussia* and coffee.

Natural Enemies

This insect would be a far greater pest were it not for its many natural enemies, two internal parasites, the California ladybird beetle and the larvae of three syrphid flies.

E. O. Essig

Black Scale. See *Apricot Pests.*

California Angular-Winged Katydid

Microcentrum laurifolium Linn.

General Appearance

Large green long horned grasshopper or katydid, from one and a half to two and a half inches long. Easily distinguished from the ordinary grasshoppers by the long, thin antennae and slender hind legs. The eggs are oval and flat, white in color, laid so as to overlap like shingles. They may be laid in a single row around the edge of the leaves or on the young stems, or in double rows on the latter. The young katydids are bright green and appear to be all legs and antennae. The adult females have a characteristic sickle-shaped ovipositor.

Life History

The eggs are deposited in the fall and constitute the winter stage. In the spring the young katydids escape from the exposed ends and immediately begin work upon the foliage, continuing their destructiveness throughout the spring, summer and fall. The broods are uneven, so all stages may be found throughout the summer.

Distribution

Throughout the entire state, but especially common in the citrus-growing sections. More damage is done in the Sacramento valley than anywhere else.

Food Plants

Particularly destructive to orange trees. Usually the foliage is the only part affected, but occasionally they gnaw into the young fruit, producing deep and ugly scars which render it unfit for market.

Control and Natural Enemy

The egg parasite (*Eupelmus mirabilis*) is practically responsible for the control of this pest and may be relied upon to keep it down to where great or excessive damages can not result. It is wise to collect the eggs during the winter and place them into boxes covered with screen. As the small parasites gnaw their way out of the egg through small holes at the top they may escape to continue their good work, while any young katydids that may hatch out cannot escape because of their long legs and antennae. It is very difficult to secure colonies of the eggs without finding many showing the holes made by the parasites.

CANTALOUP FLY. See *Cantaloup Pests.*

Chaff Scale

Paralatoria pergandii Comst.

General Appearance

Small, circular, elongated, irregular scales with first exuviae near the side. Male scales are decidedly longer than broad. The color is a light gray.

Life History

Quite a prolific species which does not spread very rapidly. The breeding continues through the summer and fall months and the broods overlap as in the other armored scales. The trunk, large and small limbs, foliage and fruits are attacked.

Distribution

Florida and a few localities in California. It has also been found in a few other localities in the southern part of California, having been imported from Florida.

Food Plants

Orange, lemon, *Japonica* sp. All parts of the plants and the fruits are attacked.

Control

Fumigation with full schedule No. 1. For fumigation schedule see p. 1499. This is not a very difficult pest to combat.

Citrus or Greenhouse Mealy Bug

Pseudococcus citri Risso

General Appearance

Small mealy-coated soft-bodied insects, from one-fourth to three-eighths inches long and two-thirds as wide. They are specially characterized by a large amount of white waxy secretion covering the bodies. There are no perceptible wax tails or appendages.

Life History

The eggs are deposited in loose cottony masses by the females upon the food plants, mostly during the late fall and winter months, though some may be laid in summer. The young upon hatching move about very freely, seeking suitable feeding places upon the tender foliage or young fruit. The females continue to move at will throughout their existence,

but the young males soon spin a small white cocoon in which to pupate. Transformation requires but a short time, the two-winged males emerging when the females are about half grown. After copulation the males die and the females continue to develop for some weeks or months before egg-laying begins.

During the spring months the young are to be found in great numbers, but by summer they have so hidden themselves as to give the general impression that the pest leaves the trees during that period. In the fall the adults begin to deposit the large masses of eggs which make them more conspicuous. The entire strength of the female is converted into eggs, only the shriveled and dry skin remaining after all have been deposited.

The insect naturally hibernates during the winter in the egg state, but due to the uneven hatching caused by the warm weather in the southern part of the state, practically all stages of the young and the adult males and females may be also abundant during the winter months.

Food Plants

Works on a great variety of plants. The fruit as well as all tender growing parts of the plant are attacked.

Control

The control of this pest has been somewhat complicated and unsatisfactory, although at the present time considerable or complete success attends the efforts of careful work. Without doubt the best control measure is the application of a carbolic acid emulsion spray, which should be applied plentifully, from 10 to 15 gallons to an average size tree, and under a pressure of 200 pounds. We have found that two angle "Bean Jumbo" nozzles on a "Y" to each rod give best results. Large-holed disks should be used in the nozzles to insure a coarse driving spray.

If the mealy bug is present in great numbers it may be necessary to make two, three or even four applications a week or so apart.

During the winter, when there are large numbers of egg masses, or in the spring when the young are hatching, is the best time for applying the sprays.

Fumigation has often given excellent killing results, but is not at all recommended for this pest, unless some other destructive scale insect, such as red, yellow, black or purple scale, is present and needs that treatment. Experience has shown that an excessive dose gives little better result than the ordinary black-scale dosage (one-half to three-fourths of Schedule No. 1 at the end of this section).

Natural Enemies

The ladybird beetle, *Cryptolaemus montrouzieri*, is the most important natural check.

Citrus Thrips

Euthrips citri Moulton

General Appearance

The adult thrips are orange-yellow in color, with the thorax and the second antennal segment orange-brown. They are very minute; so small as to be scarcely observed by the average orchardist, being less than one-thirtieth of an inch in length and one one-hundredth of an inch in width. The presence of this insect is usually ascertained by the work, which consists in scarring the fruit in such a way as to form nearly regular circles around the stem and blossom ends, although these scars may extend almost over the entire surface. They also cause a characteristic crinkling and thickening of the young citrus foliage, just as the buds are unfolding.

Life History

The winter is spent in the adult form, which hibernates in various protected places. The thrips become especially abundant about the time the citrus trees are in bloom and begin their work as soon as the petals fall and continue throughout the summer. The eggs are laid from May to August, hatching in six or ten days. The larvae greatly resemble the adults but are at first somewhat lighter in color. In from six to eight days they change into the pupal stage, and in another three to five days become adult insects. The entire life cycle, from the laying of the egg to the beginning

of the egg-laying of the adults of the second generation, is about 20 days. There are from eight to ten generations a year in the San Joaquin valley, as estimated by Jones and Horton.

Food Plants

Citrus, pomegranate, European grape varieties, California pepper tree, "umbrella tree," pear, apricot, peach, European plum varieties, olive, European raspberry, rose. The work upon oranges sometimes results in great losses.

Control

So far the best results in controlling the citrus thrips have come from spraying, experiments being conducted in California and Arizona with very good results. Two sprays were used in the work, lime-sulphur diluted at the rate of one part to 80 parts of water, and tobacco extract (40 per cent nicotine) diluted one part to 1,800 parts of water. The lime-sulphur causes slight burnings, but otherwise is as effectual and much less expensive than the tobacco extract. Four applications are recommended: the first just after most of the petals have fallen; the second in ten to 15 days after the first; the third from three to four weeks after the second and the fourth during the months of August or September, when the thrips are numerous on the foliage. In spraying for this insect it is advisable to use angle nozzles and from 175 to 200 pounds pressure, care being taken that every portion of the tree is thoroughly drenched.

Citrus White Fly

Aleyrodes citri Riley and Howard

General Appearance

The adult white flies are about one-tenth of an inch long; have yellow bodies and opaque wings covered with a fine white powder. The males have a characteristic tuft on the under side of the abdomen. The pale yellowish-green eggs are suspended on short stalks. The first hatched young have legs and antennae like a small scale insect, but after moulting these disappear and the body becomes flat, greatly resembling a soft scale. The development of the insect takes place in the flattened shell, which gradually becomes raised, showing segmentation and yellowish color. The adult emerges by breaking through the top of the skin.

Life History

The winter is passed in the mature larval stage on the under sides of the leaves. Early in the spring the pupae appear and in March and April the adults emerge. The eggs are deposited upon the foliage, the larvae beginning to hatch in about three weeks. The first hatched have legs and appendages and greatly resemble a young scale. They soon settle to feed and after several months move no more until the adult stage is reached. There are several overlapping broods each year.

Food Plants

The principle food plants of economic importance are citrus trees.

Control

By far the most effectual control measure is fumigation, as used for scale insects, two-thirds of Schedule No. 1 being recommended, see p. 1499. Emulsions and resin sprays are also effective remedies.

Cottony Cushion or Fluted Scale

Icerya purchasi Mask.

General Appearance

The adults are distinguished by large, white, fluted cottony masses with distinct red or yellow bodies, varying from one-fourth to one-half inch in length and three-fourths as wide. There are two varieties, as follows: *Icerya purchasi* var. *Crawit* Ckll., of which the body proper is yellow or light brown, and *Icerya purchasi* var. *Maskelli* Ckll., the body of which is very dark brown or almost black. The eggs and young are bright cardinal red.

Life History

The large cottony masses are the egg-sacs of the females, and may contain from 400 to 1,000 eggs. The males soon after hatching secrete themselves in a white cocoon for transformation, which requires nearly one month. The females are matured in from three to four months. There are several broods during the sum-

mer, when the scale increases enormously and may do great damage.

Food Plants

All citrus trees, *Acacia baileyana*, *Acacia melanoxylon*, pomegranate, quince, apple, peach, apricot, fig, walnut, locust, willow, pepper, grape, rose, castor bean, spearmint, rose geranium, purslane, ambrosia, flowering almond, pecan, potato, Bermuda grass.

Control

Artificial control by sprays and fumigation are never practiced because of the efficiency of natural enemies. This is the one case where nature controls perfectly a serious pest.

Predaceous Enemies

The common Vedalia (*Novius cardinalis*) and the Koebele's ladybird (*Novius koebelei*) are the ladybird beetles which keep the cottony cushion scale in complete subjection. In many localities the former is the most efficient, but in some places, and especially in Ventura county, the writer found the latter doing most of the control work.

While these ladybirds are usually present in limited numbers in most sections, yet at times they completely disappear and the cottony cushion scale increases so as to cause considerable damage before the beetles can again be established. It is always well to keep a close watch of this pest, and if it appears without being accompanied by the larvae of the Vedalias, adults of the latter should be obtained and liberated as soon as possible.

True Parasites

There are two true parasites which also prey upon this coccid: the hymenopterous enemy, *Ophelosia crawfordi*, and the dipterous parasite, *Crytochaetum* (*Lestophonus*) *iceryae* Will. The latter is often responsible for as much effective work as are the Vedalias, though this fact is not generally known.

COTTONY MAPLE SCALE. See *Apple Pests.*

Florida Wax or White Scale

Ceroplastes floridensis Comst

General Appearance

White or pinkish waxy scales, oval in form, convex above and concave beneath, from one-twelfth to one-eighth of an inch in diameter. The upper surface is evenly and beautifully lobed. The body is red and seen through the white wax gives the pinkish color.

Life History

The eggs, one-hundredth of an inch long, are dark red and vary from 75 to 100 to each female. The young hatch beneath the scale and soon after leaving settle to feed, first upon the leaves, and then upon the stems and smaller branches. The wax shell forms with the growth of the females. There are from three to four broods a year, covering a period from April to November.

Distribution

Very limited in hothouses.

Food Plants

Citrus trees, quince, apple, pear, fig.

Control

It is seldom that this insect becomes so numerous as to be destructive, but this has occurred. Spraying should be done before the waxy covering is formed. Resin wash or kerosene emulsion are recommended.

FLUTED SCALE. See *Cottony Cushion Scale*, this section.

FROSTED SCALE. See *Prune Pests.*

FULLER'S ROSE BEETLE. See *Rose Pests*, under *Floriculture*.

Glover's or Long Scale

Lepidosaphes gloverii Pack.

General Appearance

Greatly resembles the purple scale, *Lepidosaphes beckii*, but is much straighter, longer and very narrow. The color is also somewhat lighter.

Life History

Practically the same as the purple scale, but not so prolific or destructive.

Food Plants

Citrus trees, foliage and fruit; palms and *Magnolia fuscata* are attacked.

Control

Same as for purple scale.

Grain or Strawberry Thrips

Euthrips tritici Fitch

General Appearance

Very minute, being from 0.029 to 0.031 of an inch in length. The color is yellow, with orange-tinted thorax.

Life History

The eggs are very minute, globular in shape and red in color. They are inserted within the tissues of the host and hatch within a few days. The nymphs or young greatly resemble the adults, and begin to feed at once. The principal damage is done to the blossoms of the host. Strawberries especially suffer from their attacks. According to Professor Quaintance, the pistil is the portion of the blossom destroyed. The winter is probably passed in the soil, as in the case of the pear thrips (*Euthrips pyri*).

Food Plants

Strawberry, orange, rose, lilac, grass.

Control

This insect is seldom destructive enough to warrant control. The sprays used for pear thrips (except whitewash) are effective in controlling this pest.

GREENHOUSE MEALY BUG. See *Citrus Mealy Bug*, this section.

Greenhouse Thrips

Heliothrips haemorrhoidalis Bouche

General Appearance

The adult insect is characterized by having the antennae eight-segmented and twice as long as the head, while the surface of the body is distinctly reticulated. The abdomen is yellowish brown, with head and thorax dark brown and antennae, legs and wings colorless.

Life History

The very minute, bean-shaped, colorless eggs are inserted in the leaf tissues of the food plants, usually on the underside. They hatch in about ten days. Each female lays from 10 to 20 eggs.

Food Plants

Citrus, azalea, *Aspidium*, crotons, dahlias, phlox, verbena, pink, ferns, vines, cherry, laurel, laurestinus, palms, *Ficus* sp., *Pellaea hastata*, *Liliaceae*, fuchsia, mango, begonia, cattleya, grape, Norfolk Island pine, smilax. On citrus the fruit as well as the foliage is scarred.

Control

Sprays recommended for pear thrips (*Euthrips pyri*) are also applicable for this pest, but in spraying tender greenhouse plants these should be weakened to two-thirds normal strength. In spraying for the greenhouse thrips on citrus trees, use the formulae recommended for citrus thrips (*Euthrips citri*).

Fumigating may be employed if the greenhouses can be made reasonably tight, using one-third to one-half of an ounce of potassium cyanide to every 100 cubic feet of space, proceeding as directed for orchard fumigation work.

Natural Enemies

Mites prey upon this species to a considerable extent, but render little reliable aid.

GREEN PEACH APHID. See *Peach Pests*.

HEMISPHERICAL SCALE. See *Peach Pests*.

IVY SCALE. See *Apple Pests*.

JAPANESE WAX SCALE. See *Okra Pests*.

LONG SCALE. See *Glover's Scale*, this section.

MELON APHIS. See *Aphids*.

Orange Chionaspis

Chionaspis citri Comst.

General Appearance

The female scales are elongated, blackish-brown in color, with gray margins and dark-yellow exuviae. The male scales are very small, long and narrow, white with exuviae yellow. They are often grouped so thickly as to almost hide the females and make the branches appear white.

Life History

Practically the same as that of *C. euonymi*.

Food Plants

Its favorite food plant is the orange, though other species of citrus trees are attacked as well as holly, palm.

Control

Fumigation as for red or purple scales will easily control this pest.

E. O. ESSIG

Orange Maggot

Trypeta ludens Loew

This is an insect that is a serious pest of oranges in Mexico. The larva or maggot develops within the fruit similar to the codling moth within the apple. From four or five to 15 or 20 of these maggots may occur in a single orange. The eggs from which these maggots hatch are deposited on the fruit. About 70 eggs are laid by a single fly, and these are distributed over from eight to a dozen oranges. When the worm has attained its growth it leaves the fruit, which usually falls. In case it does not fall, the maggots drop to the ground. The complete life cycle requires about three months.

Appearance of the Orange Maggot

The larva or maggot is dirty white in color and when mature measures slightly less than one-half of an inch long. This is the stage of the insect that occurs in the pulp of the orange. The puparium, which is the next stage, is light brown in color, barrel-shaped and measures about one-third of an inch long. The adult fly is straw yellow in general color with brownish markings on the wings, which when spread measure about five-sixths of an inch across.

H. J. QUAYLE.
California Experiment Station Bulletin 214.

Orange Tortrix

Tortrix citrana Fern
(Family *Tortricidae*)

General Appearance

The adult insects are gray in color and hardly one-half inch long. The eggs are cream-colored, circular, flat and covered with fine mosiac-like markings. They are laid so as to overlap like the scales of a fish. The larvae when full grown vary from one-half to three-quarters of an inch in length and are white or dusky in color. The chrysalids are brown.

Life History

The eggs are laid in clusters in early spring, usually upon the undersides of the leaves, each moth depositing about 50. The larvae hatch in about two weeks and feed upon the surface of the orange fruit or upon the foliage or tips of the shoots of the other hosts. Burrows are also made in the fruit, especially throughout the peel, thus causing decay and ruin. The young reach maturity in about two months. The pupal stage is passed within the old burrow or any protected place outside. The adults emerge in from one to two weeks. The broods overlap, but there are probably three generations a year.

Food Plants

The greatest damage is done to the fruit of the orange, by making burrows throughout the peel and often into the pulp.

Control

Though the destructiveness to oranges has been quite great in a few instances, yet not enough actual damage has been done to warrant the application of poison sprays or other methods necessary for control. The parasitic braconids which work upon the larvae no doubt play some part in the subjection of the pest.

Natural Enemies

The tachina fly (*Phorocera parva* Bigot) and the internal braconid parasites.

Purple Scale

Lepidosaphes beckii Newm.

General Appearance

The female scales are elongated, oyster-shaped, varying from one-sixteenth to one-eighth of an inch in length and one-third as wide. The male scales are much smaller than the females. The scale or covering varies from a reddish brown to a rich purple color, giving rise to the name.

Life History

The pearly white eggs are laid in the large sac under the protecting scale. From these are hatched males and females, which mature in from four to six months. The fruit, limbs and foliage are attacked.

Distribution

Throughout the coast citrus belt of Southern California. Also occurs in various places in the San Joaquin and Sacramento valleys.

Food Plants

All citrus species, fig, olive, croton, oak.

Control

Fumigate with full schedule No. 1. This is usually done when the black scale (*Saissetia olae*) is in good condition to kill. See p. 1499.

Natural Enemies

The ladybird beetles, *Orcus chalybeus*, *Scymnus marginicollis*, *Lindorus lopanthae;* the larvae of the green lacewing, *Chrysopa californica* Coq., and brown lacewing, *Sympherobius angustus* Bks., and the internal parasite, *Aspidiotiphagus citrinus* Craw., prey upon this pest.

RED ORANGE SCALE. See *Grape Pests*.

RED SPIDER. See *Apple Pests*.

Silver Mite of the Lemon

Eriophyes oleivorus Ashm.
Phytoptus oleivorus Ashm.

General Appearance

The adult mites are so small as to be invisible except with the aid of a lens. They are light yellow in color, long and pointed anteriorly, with two pairs of legs near the head. The eggs are exceedingly small, circular and faintly yellow in color. The presence of the mite is easily told by the characteristic silvery chafing of the skin of the lemon, due to the destruction of the oil cells. In Florida the oranges are also chafed, causing a russeting.

Life History

The eggs are deposited singly or in small clusters on the leaves or fruit. They hatch in less than a week in hot weather but require twice as long in cold weather. After several molts the mites become full grown in from two to three weeks. The young and adults feed upon the oil in the succulent parts of citrus plants, which is obtained by piercing the oil cells with their beaks. The adults are capable of rapid locomotion and move freely. They breed from spring until late fall, giving rise to many overlapping broods a year.

Food Plants

Works upon bark, foliage and fruits of citrus trees. In California its attacks are usually confined to the lemon.

Control

Same as for the citrus red spider, *Tetranychus mytilaspidis*.

STRAWBERRY THRIPS. See *Grain Thrips*, this section.

TWELVE-SPOTTED CUCUMBER BEETLE. See *Cucumber Pests*.

Long-Tailed Mealy Bug

Pseudoccus longispinus Targ.
Pseudococcus adonidum Linn.

General Appearance

The same as the citrus mealy bug in size, shape and color, but is readily distinguished from it by the long white anal appendages as long, or longer, than the body, from which it gets its name.

Life History

No eggs are laid by this species, the young being born alive. Several generations appear each year, in fact in the southern part of the state the breeding extends throughout practically the entire year. The life cycle occupies about two months. It is particularly bad in greenhouses and ornamental gardens.

Food Plants

Is especially destructive to *Dracaena* sp., but also occurs on moonvine, citrus, coleus, sago palm (*Cycas revoluta*), ferns, oleander, plum, staghorn fern.

Control

The same as for the citrus mealy bug.

WHITE SCALE. See *Florida Wax Scale*, this section.

Woolly Citrus Aphid

Aphis cookii Essig

General Appearance

The bodies vary from light gray to very dark brown or almost black, and are covered with short or rather long, white cottony wax, which is arranged in transverse rows across the abdomen. This covering often almost completely hides the insects.

Life History

Is not well known. The insect was first discovered by C. H. Vary at Pomona, California, in April, 1910.

Food Plants

Navel orange trees.

Yellow Scale

For CONTROL, see *Red Scale*, under *Grape Pests*.

DOSAGE TABLE FOR FUMIGATION

The amount of cyanide used depends upon the pest to be treated. Accordingly several schedules (Fig. 1) have been made, based upon dosage schedule No. 1 for purple or red scale, made by R. S. Woglum. This dosage consists of 1½ ounces of potassium cyanide to every 100 cubic feet of air space. The schedule dosage for black scale usually consists of three-fourths of schedule No. 1 and is designated dosage schedule No. ¾.

If sodium cyanide is used the dosages are reduced 25 per cent.

Black Scale

Either dosage schedule No. ¾ or ½ for potassium cyanide or ½ for sodium cyanide. The smaller dosage is recommended only where there is an even hatch of very young scale insects.

Purple, Red, Yellow Scale

Use dosage schedule No. 1 for potassium cyanide and No. ¾ for sodium cyanide.

Mealy Bug

The same dosage as for black scale gives almost as good results as the heavier doses.

Length of Exposure

The time required to complete the generation of the gas is not long, but it is advisable to leave the tents upon the trees for at least 45 minutes after the dosage is placed under the tent. Some prefer 30 minutes, while others insist upon a full hour.

Distance Around Trees

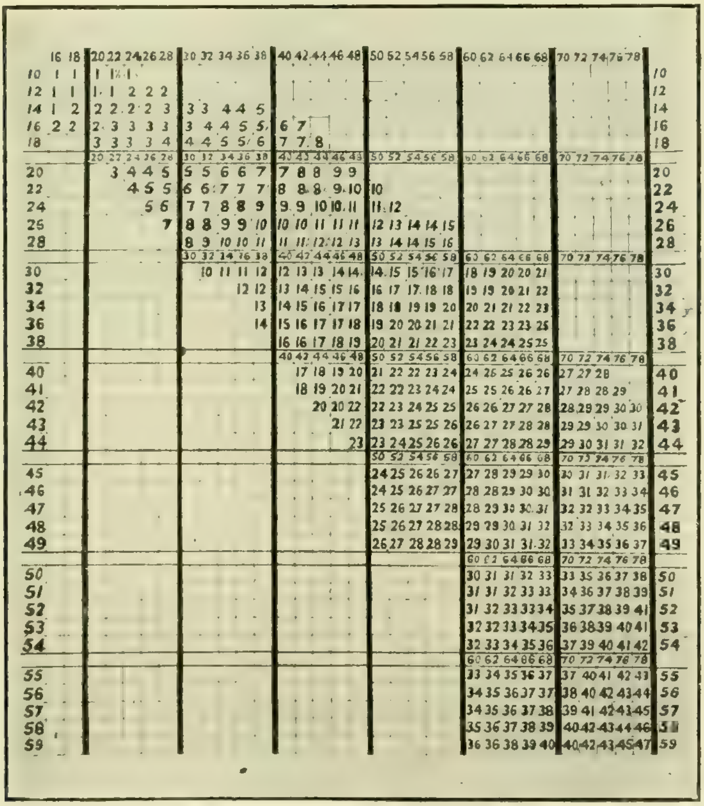


Fig. 1. Schedule No. 1. The first few dosages should be doubled. (U. S. Department Agriculture.)

Orchard Brush Burner

When I was in Southern Oregon not long ago I saw what was to me a new implement. It was a home-made affair that was the outgrowth of the necessity for getting rid of orchard prunings. H. F. Meader, of Jackson county, Oregon, who is an up-to-date orchardist, conceived the plan of building a portable brush burner, in which the refuse left after pruning could be got rid of without the trouble of hauling it out of the orchards. He made a frame or running-gear of four poles about six inches in diameter, using two for axletrees about seven feet long, and on top of these two others about ten feet long were bolted near the ends, forming a rectangle. To the under side of one was fastened a round iron rod, whose projecting ends were used as spindles for two old farm implement wheels about a foot in diameter. These wheels were held in place by linchpins that were put through holes made in the ends of the spindles at the blacksmith shop on the farm. The burner proper was a huge iron basket or crate, about six by ten feet on the bottom by two feet deep, made of old wagon tires riveted together. The meshes of this crate were nearly a foot in diameter, which was sufficiently close to hold the brush. The bottom was covered with old sheet-iron scraps to keep the coals from falling through and thus hold the fire.

On one end, which was the front, and next where the team was to be hitched, it was sided up to the top with sheet iron, to prevent too much radiation of heat in that direction. Chains or iron rods were fastened to the front end and extended about ten feet forward to put the team a proper distance from the fire.

This crude apparatus, made on the farm out of old scraps, served a most excellent purpose. It was taken into the orchard where the brush was on the ground; a fire kindled in it, and as the brush was piled on and consumed it was dragged forward and more brush added, until one row after the other was burnt and out of the way.

Mr. Meader told me that some of his neighbors made fun of it, and thought it was not practical, but a few borrowed it of him, and now there are several in the vicinity.

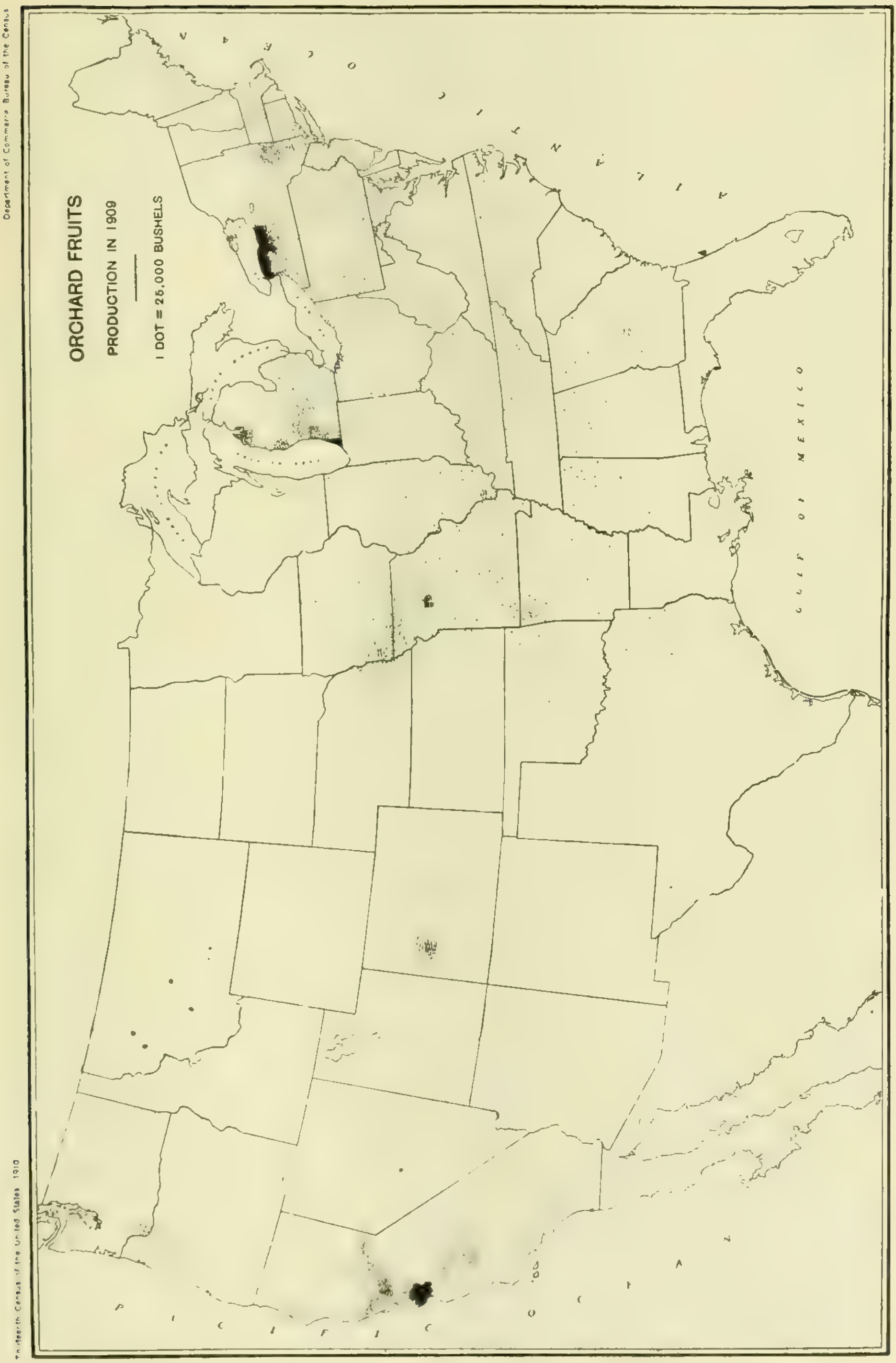
There is lying about almost every farm some material, such as old iron wheels, axles, wagon and buggy tires, that might be made into one of these handy brush burners, with the aid of a blacksmith and at little expense, provided there is no forge on the farm to lessen the cost still more. The frame should not be weak, or it might heat and sag to the ground. Let there be hundreds of these brush burners made without delay by our orchardists and put to use. Several neighbors might own and use one together. This will turn the brush into ashes and spread them in the orchards, where they should be, and save about half the expense of getting rid of the brush.—H. E. Van Deman in Rural New Yorker.

Oregon

Oregon has an area of 94,560 square miles and is seventh in size of the states of the Union.

There are three great ranges of mountains dividing the state from north to south with cross ranges here and there running east and west. There is what is called the Coast range, from 10 to 30 miles from the Pacific ocean; the Cascade range, from 110 to 150 miles inland; and the Blue mountains in the eastern part of the state.

The extreme altitude of the Coast range is about 4,000 feet; the Cascades are nearly 7,000 feet, with several peaks rising far above the general range, like Mount Hood, 11,500 feet; McLaughlin, 11,000 feet; and Jefferson, 10,500 feet. The Cascades are heavily timbered to the snow line, and all that part of the state west of the Cascades is forest. Eastern Oregon is a high tableland, embracing about two-thirds of the state. The rainfall of this section is light, about enough to grow wheat, but there are fertile valleys along the lakes and rivers in the Blue mountains and in the southern portion of the state. There is about 300 miles of coast line, rugged and precipitous, except a few bays and harbors like Tilla-



Map Showing the Distribution of the Orchard Industry in the United States.

mook. Winchester, Coos and Cape Blanco.

The largest river is the Columbia, into which empty the Snake, Umatilla, John Day, Deschutes and the Willamette rivers. The principal lakes are Klamath, Goose, Warner, Salt, Christmas, Albert, Summer, Silver Henry, and Malheur. Crater lake in the Cascades, 8,000 feet above sea level, is the crater of an extinct volcano 10 miles in circumference, and surrounded by bluffs 2,000 feet high. It is said to be the deepest body of fresh water in America.

The climate is varied, depending largely on relations to the coast and to the high mountain ranges. The Japan current sweeps down the coast, modifying both heat and cold west of the Cascades, and in some degree east of that range.

The rainfall in the western part averages 89.6 inches; in the Willamette valley, 50.8 inches; in the east, 12.7 inches; and in the central portion, 6.5 inches.

The character of the soil is different in the different valleys of Oregon. For instance, in Rogue River valley, the soil is largely decomposed granite mixed with basalt; in the Umpqua valley, clay predominates, with alluvial sands in the river bottoms; in the Willamette valley, the soil is generally heavy, with streaks of sandy loam; in the Columbia valley all kinds of soil exist from drifting sands to the compact clays.

The most famous apple-growing section in the state is the little valley of Hood River, about 20 miles long and from four to five miles wide on the average. It grows a very fine quality of fruit which is put up and marketed in the most attractive style, therefore bringing the highest prices. Next to this in the state of Oregon is the Rogue River, justly famous as a fruit-growing section, and next is the Willamette, where perhaps cherries are grown as successfully as in any other place in the United States. There are other fruit sections coming into prominence, but these named are the most famous. Peaches, prunes, English walnuts, small fruits, in fact all kinds of fruits grown in the temperate zone, seem adapted to some part of the state of Oreon.

Professor C. I. Lewis, chief of the Division of Horticulture, Oregon Agricultural College, says: "The Rogue River valley in Southern Oregon contains about 45,000 acres of fruit land, 30,000 acres of which is in pears, the Bartlett being the leading variety, while the Comice, D'Anjou, Bosc and Winter Nelis are popular varieties. The apples planted in this section are Yellow Newtown, Spitzenburg and Jonathan. The land values in this district run from $25 to $50 per acre back in the hills, while close to some of the central orchards it will run from $500 up to $2,000 per acre.

"In the Hood River district we have some 15,000 acres devoted to apples. The leading variety of apples grown in this district is the Spitzenburg, while some of the other varieties are Newtown, Ortley, Jonathan, Red Cheek Pippin and Gravenstein. Land in this district sells all the way from $300 up to $2,500 per acre.

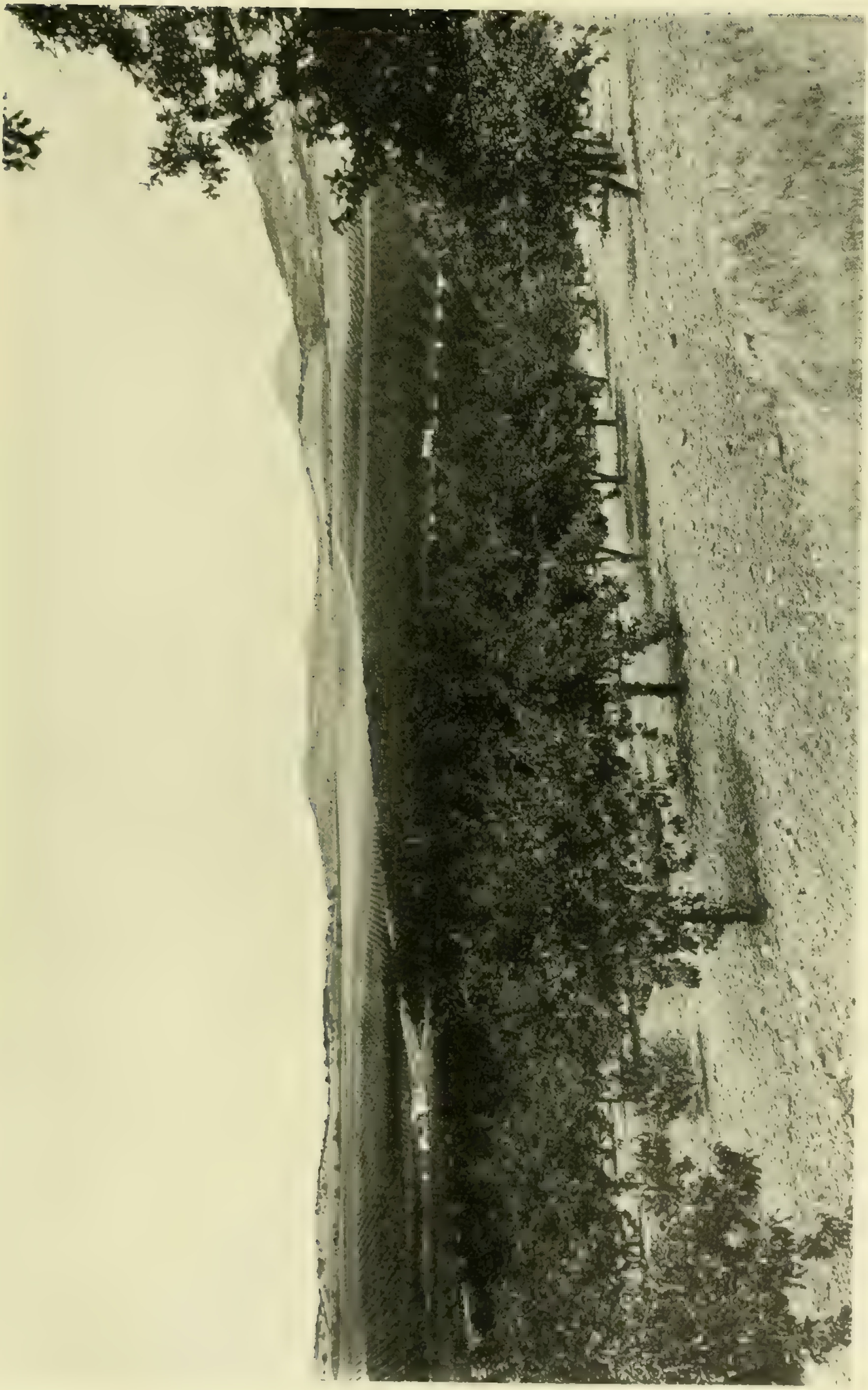
"In the Grande Ronde valley will be found about 5,000 acres of fruit land, principally of mixed orchards, with the apple predominating, the leading varieties being Jonathan, York Imperial and Black Twig. At Freewater-Milton will be found 3,000 acres principally of mixed orchards.

"In The Dalles and Dufur district are some 4,000 acres of fruit land. At The Dalles, cherries, prunes and grapes are the leading fruits, while at Dufur many apples and pears are grown as well.

"Willamette valley contains about 40,000 acres of fruit land. While 12,000 of it is pear land, yet apples, walnuts, etc., grow to a wonderful degree of perfection.

"The Umpqua valley contains about 3,000 acres of fruit land. However, the orchards in this district are still quite young.

"Possibly throughout the rest of the state will be found 3,000 or 4,000 acres planted to fruit trees. Not over 15 per cent of the fruit trees in Oregon are in bearing. The average yield of an orchard is much less than people generally suppose. Many orchards are planted on poor



Rogue River Valley. Orchard of Mr. W. G. V. Campbell.

soil, have never borne, and perhaps never will. Pears pay higher than apples; they average $300 to $500 per acre, while apples average about $200. In Western and Southern Oregon we like the clay loams as they are more retentive of moisture, but in sections where irrigation is practiced we like the lighter soils as they are worked more easily and are not troubled with a surplus of water."

Eastern Oregon

Eastern Oregon has not made the development in the fruit industry that has been made in the central and western portions of the state. This may be due to the physical conditions, that make fruit growing less profitable than in other parts, or it may be due partly to lack of transportation facilities, which until recently was a great bar to settlement. However, of late a great many orchards have been planted, that are not yet in bearing and that promise good results.

At Baker a large acreage has been planted in the belief that they will produce rich returns.

In the Grande Ronde valley the soils are rich alluvial deposits and trees are being planted.

At La Grande there are some of the oldest orchards in Eastern Oregon, and apples have proven a success.

At Cove apples, cherries and other fruits are grown successfully.

At Freewater and Milton, in the Walla Walla valley, all kinds of deciduous fruits are grown, but apples, prunes, peaches and pears, are the principal fruits.

At Umatilla is a Government irrigating project, in which the land is sold in 40-acre units. The soil is sandy in character and seems to be well adapted to strawberries, raspberries, blackberries, grapes, peaches, pears and early apples. The success of winter apples, for commercial purposes, is yet to be tested.

In the Eagle, the Pine and the John Day valleys there are some old orchards, mostly "family orchards," but the success of these has given encouragement for the planting of commercial orchards on a broader scale.

Summer lake is well adapted to the growing of such fruits as winter apples, especially the Spitzenburg and Winter Banana; also the tenderer fruits such as peaches and apricots may be grown. The soil is a sandy loam and the water from the lake has doubtless modified the atmosphere so as to protect from frost.

At The Dalles, on the Columbia river, prunes, grapes, cherries and apples are grown for commercial purposes.

Of the Hood River valley we have already written in brief, but the district deserves further mention and we give here a description by Professor Lewis, as follows:

"This district has earned world-wide reputation for its apples. Yellow Newtown and Spitzenburg are the principal varieties. It has about 10,000 acres in orchards; has seven or eight different types of soil, all of which grow fruit successfully when supplied with humus and when deep and drained thoroughly both as to air and soil. The region which is directly above the town of Hood River is known as the lower valley, while in the vicinity of Mount Hood is the upper valley. In the upper valley we find rich fertile soil, but as yet few bearing orchards in that district. With the proper handling the prospects are very encouraging for orcharding. The elevation of Hood River valley ranges from 600 to 2,500 feet. The rainfall is about 35 inches. The main apples are Yellow Newtown, Spitzenburg, Ortley and Jonathan.

"Between Hood river and The Dalles is a small valley known as the Mosier district. This district has much the same conditions as are found in the Hood River valley. Formerly a great many prunes were grown in this district, but it is becoming chiefly an apple district, producing such varieties as Newtown, Spitzenburg, Ortley, etc."

Willamette Valley

This valley is about 150 miles long and 60 miles wide, undulating, rich, and beautiful. It extends southward from Portland, and in some respects is the richest agricultural portion of the state. There is little or no irrigation practiced here

because the rainfall is from 30 to 60 inches and is sufficient for the growing of ordinary crops. We quote again from Professor Lewis, who is perhaps better acquainted with this region than any other writer, being located in his professional work at Corvalis, which is situated in the valley, and is the seat of the State Agricultural College:

"It is a valley of great variations and wide adaptability. The river bottom lands are splendidly adapted for peaches and truck crops. Cherries have also done well on these bottom lands, and orchards of apples and pears in a number of cases are making successful growths. Young walnut trees planted on many of these lands have made splendid development. Whether they will prove to be apple and pear lands on an extensive scale will need further demonstration, the one point being that excessive frosts might damage such crops where the orchard locations were at the base of benches quite a distance from the river. Directly above the river soils, which are generally sandy and silt soils, we find especially in the upper part of the valley quite extensive areas of so-called white land. Fruit has never been grown on these lands to any great extent, and probably never will be grown until drainage has been undertaken, although with drainage the pear can, in all probability, be successfully grown in preference to other fruits. Apples likewise would be very promising. Small fruits do especially well on such lands. Between these white lands and the foothill lands will be found the gently rolling clay loams, splendidly adapted for apples and pears.

"In the lower part of the valley in such counties as Washington, Yamhill, etc., are found such areas as we might term tablelands, tending from an elevation of 500 to 1,500 feet, or in some cases to the very base of snow-capped peaks. Where these are deep and contain strong clay loams they are splendidly adapted for the growing of apples and pears. Some of the lighter loams seem adapted for the growing of cherries and prunes. Wherever of great depth walnuts should also thrive.

"The foothill lands which one finds extending from the tablelands south to the white lands of the valley are, as a whole, more adapted for prunes and cherries than for any other crops. They are apt to be thin and poor to the west and south exposure, but deep and of greater value to the north and east; it is true not only in this valley but also in the valleys found to the south; there seems to be a general tendency for these hill lands to become poorer as they extend southward.

"The Willamette valley is the center of the famous Italian prune industry and the cherry industry of the state. The principal walnut interests of the state are also found in this valley, while the apple and pear industries are also increasing rapidly."

Umpqua Valley

The Umpqua valley lies south of the Willamette and north of the Rogue river, has a rich soil, the surface gently rolling, and has about 25 inches of rainfall. Part of its agricultural areas are irrigated. It is said to be the earliest valley in the state for the production of cherries and strawberries for the markets. Parts of the valley are also adapted to the growing of apples.

Rogue River Valley

What is generally called "The Rogue River valley," is composed of two arms of the main river, one rising in the Cascade range, northeast of Medford, the principal town, and the other rising in the same range toward the southwest. They are hemmed in on every side by ranges of mountains or hills, except toward the westward, where the river flows toward the Pacific ocean. There is for these reasons a meeting of air currents and counter currents that without artificial protection would cause injury from frosts in greater degree than in most fruit-growing sections of the state. However, this fact has caused the development of the best system of orchard heating, perhaps, in use among the fruit growers of the United States. (See under *Frost.*)

The apple best adapted to the Rogue river is said by experts to be the Yellow Newtown. The orchard section is at an elevation of about 1,100 to 1,600 feet

above the level of the sea. Perhaps in no part of the United States have pears proved more profitable than in the Rogue River valley. Here too, they have had to fight "pear blight" with a great deal of vigor and have taught the orchardists of many other sections valuable lessons on this subject.

GRANVILLE LOWTHER

*Varieties of Fruits for Oregon

The subject of variety adaptation in the Pacific Northwest is still in its infancy. Since the greater part of the acreage in orchards is still not in a bearing state, it will be some time before final conclusions can be adopted concerning the best varieties to grow under the various conditions to be found in each locality. There is a tendency in the state to plant in some cases too few varieties, or rather try to adapt a few varieties to all conditions.

For the principal varieties of apples, the Spitzenburg, one of the most popular varieties, is one only adapted to deep rich soils with warm sunny exposure. This variety is subject to all the troubles a tree is heir to; it needs constant nursing and careful handling, and is only profitable when grown to a high degree of perfection, as the second and third grades of this variety are often a drug on the market.

The Jonathan apple is an apple of quite wide adaptability, but to be at its best should develop a high degree of color; it needs careful handling at the time of picking, as it develops core rot and breaks down rapidly if allowed to hang on the tree too long.

The Northern Spy in most sections of the Northwest is of rather poor quality, but some sections of the Willamette valley have been especially successful in growing this variety. It should not be placed on too rich or too heavy soil. We should discourage rank growth by the use of summer pruning and by avoiding giving the tree too much stimulation caused by too intensive cultivation or irrigation. When highly colored and not overgrown it is a very desirable apple.

* Oregon Experiment Station Bulletin 111.

The Gravenstein is a very popular apple, becoming a fall apple in most sections like the Hood River, Willamette and Rogue River valleys, but having long-keeping qualities in some of the coast counties and some of the uplands of Eastern Oregon. By careful picking its keeping season can be prolonged.

King of Tompkins county, has a great tendency to overgrow and water at the core, but when grown to a high degree of perfection it will find a ready market as a fall apple.

The Wagener is especially valuable as a filler; it comes into bearing early and is productive.

The Gano is an improvement in some ways over the Ben Davis, as it has a better color and is thought by many to be of superior quality; while a low-grade apple, it has been profitable.

The Rome Beauty is rapidly becoming one of the leading baking apples, and is steadily increasing in popularity throughout the state. It is profitable in most sections where it has been tried.

The York Imperial is grown to considerable extent in the Grande Ronde valley; it has not been tried to any great extent in other sections.

The Winesap, while grown to perfection in parts of Washington, is grown sparingly in most Oregon districts. It has a tendency to grow too small.

The Mackintosh Red is grown but sparingly in this state as a high-class Christmas apple; it would be adapted to high elevations and localities or severe weather conditions.

The Russian apples are usually adapted to more or less hardship, and often succeed on the high elevations and bleak exposures where others fail.

The Delicious has been grown very little as yet in Oregon and is in an experimental stage. It is probably better adapted to higher altitudes, as in low altitudes the apple is often poorly colored and too soft.

The King David is practically a new apple in Oregon. Only a few trees have as yet come into bearing, and it is too early to state just how promising this variety will be and to what conditions it will be

especially adapted. It is a productive apple of pleasing quality and is worthy of trial, but like other little-known varieties, to a limited extent only.

Of the light-colored apples the Yellow Newtown is the leader; it has wide adaptability and is now being grown to a high degree of perfection in the Hood River, Willamette, Umpqua and Rogue River valleys.

The Ortley is a popular apple in the Hood River district; it is planted considerably with Yellow Newtowns as filler and pollenizer. It is a high-quality cooking and eating apple.

Grimes Golden is increasing in popularity, especially in the Willamette valley. It is a high-class apple; at times it grows rather small and occasionally has a tendency to drop badly, but it is one of our most promising varieties.

Winter Banana has as yet little commercial rating. We believe it is better adapted to the high elevations, as the upper Hood River valley, than to other sections of the state.

White Winter Pearmain is grown splendidly in parts of Oregon; it is an apple of excellent vitality. It is a splendid pollenizer with practically everything we have tried, and in certain sections it is worthy of trying more than at present.

The Rhode Island Greening, where grown to a good degree of perfection, is of good quality and should receive more encouragement. It is successfully grown in parts of Eastern Oregon, and is increasing in popularity in some sections of the Willamette valley.

As to pears, it is the general belief that varieties like the Bartlett, Comice and Bosc are grown to a greater degree of perfection on lighter soils than on the heavier. Whether they will keep as well when grown on such soils is a question to investigate, and where it is reported that they have not kept as well when grown in such conditions, it may have been due to the fact that the crop was compared in this way: regions that had nothing but light soils against regions which had both light and heavy soils.

The Comice is being planted more than is justified. While it is high priced when grown to a high degree of perfection, it is a shy bearer, coming into bearing late, and is not as much of a money maker as many other varieties. The Winter Nelis should only be planted on the richest of soils. Pear districts should try varieties of pears at present that are not commonly grown in Oregon, such as Glou Morceau, Patrick Barry, Beurre Hardy, etc.

Varieties of Fruits for Various Localities

For the lower altitudes of Wasco, Morrow, Crook, Gilliam, Sherman and Umatilla counties, the selection can be made from the following varieties:

Apples: Yellow Transparent, Gravenstein, Jonathan, Winesap, Rome Beauty, Wagener and Ben Davis. The latter for spring use.

Pears: Practically any commercial variety, including Bartlett, Clapp's Favorite, Seckel, Anjou, Winter Nelis.

Cherries: Sweet—Lambert, Royal Ann, and Bing. Sour—Early Richmond, English Morello and Olivet.

Prunes and Plums: Use any of the standard varieties, such as Italian, Hungarian and Peach Plum.

Peaches: Alexander, Early and Late Crawford, Lemon Cling, and many other commercial varieties.

Grapes: European varieties are generally covered and protected in the winter. Such are Black Hamburg, Muscat, Rose of Peru and Tokay. American varieties are: Worden, Concord, Niagara and Delaware.

Strawberries: Clark's Seedling is the best. Practically almost any of the early, medium and late varieties would give a good family supply.

Raspberries: Cuthbert, Gregg, Marlboro and Cumberland.

Blackberries: Lawton, Eldorado and Kittatiny.

Currants: Fay, Cherry and White Grape.

Gooseberries: Red Jacket, Champion and Industry.

For the lower elevations of Union,

Baker and Wallowa counties the following varieties are found to do best:

Apples: Yellow Transparent, Gravenstein, King, Jonathan, Rome Beauty, York Imperial, Gano, Ben Davis and Hyde-King.

Pears: Bartlett, Clapp's Favorite and Anjou.

Cherries: Sweet—Lambert and Bing. Sour—Early Richmond and Olivet.

Prunes and Plums: Italian and Hungarian.

Peaches: Any of the early varieties, such as Early Crawford, Hale's Early, Alexander, etc.

Grapes: Worden, Concord, Niagara and Brighton.

Strawberries: Clark's Seedling, Sharpless and Magoon.

Currants: Fay, White Grape.

Gooseberries: Red Jacket, Industry and Champion.

The higher elevations of Eastern Oregon counties suffer more or less from the severity of the winter and drouth in summer. For these counties:

Apples: The Russian varieties will be hardiest. These varieties in low altitudes are summer and fall varieties, but often in the high altitudes they are long keepers. Red Astrachan, Gravenstein, Duchess of Oldenburg, Wolf River, Wagener and Mackintosh Red are the best and most satisfactory varieties to plant. Occasionally nearly any of the standard varieties grow sufficiently well for family use. Varieties of some promise in such sections are also Rome Beauty, White Winter Pearmain, Delicious and Gano.

Pears: White Doyenne, Seckel, Clapp's Favorite.

Peaches: As a rule they should not be grown. Occasionally such varieties as Alexander and Amsden June do very well. The Gibbs apricot is often successful.

Cherries: Sweet—Lambert and Bing. Sour—Early Richmond and Olivet.

Raspberries: Cuthbert and Turner's Red.

Blackberries: Any of the standard varieties, such as Kitatiny, Lawton and Eldorado.

Gooseberries: Red Jacket and Champion.

Strawberries: Clark's Seedling, Warfield and Bederwood.

In the districts of Central Oregon, like Goose Lake and Sumer Lake, probably any of the commercial varieties can be planted successfully. Last year a great many leading varieties of apples were found growing to a high degree of perfection, splendid in color and form, and with indications of long keeping. Such varieties as Spitzenburg, Winter Banana and Winesap were very promising. With the conditions that prevail in those regions it is probable that there is a long list of varieties that could be grown commercially.

Varieties for Hood River Valley

The leading varieties of apples in the Hood river valley are the Yellow Newtown, Spitzenburg, Ortley, Jonathan, Red Cheek, Arkansas Black.

For pears: Anjou is the leading variety and seems to grow well. Other varieties worth trying would be Bartlett, Patrick Barry, Hawell and Glout Morceau.

The varieties at Mosier are similar to those at Hood River. Very few other fruits are grown in these districts except for home use.

For raspberries: Cuthbert; and for strawberries, Clark's Seedling.

In the upper Hood River valley variety adaptation is still in an experimental stage. The Winter Banana seems to do well, and it may be that the Delicious will be good for that district, also Gano, Jonathan, etc.

In the vicinity of The Dalles we find a district especially adapted for peaches, prunes, cherries and grapes. The district above The Dalles is being cultivated to apples, varieties of which are given in another list.

For peaches the principal ones are Early Crawford, Late Crawford, Salway, Elberta, Muir, Orange and Lemon Cling, although many other varieties would do well.

Cherries: The Lambert, Bing and Royal Ann do well.

Grapes: Such varieties as Tokay and Muscat grow successfully and color beautifully.

Varieties for Willamette Valley

This is one of the hardest valleys concerning which to give advice as to the variety of fruit to plant, due to the large area of the valley and the many varied conditions that are found, and owing also to the fact that, with apples especially, the industry is still in its infancy.

Apples: Yellow Newtown, Jonathan, Grimes Golden, Rome Beauty, Gano, Rhode Island Greening, Gravenstein, Ortley, Wagener, Spitzenburg, Vanderpool Red, Northern Spy.

Pears: Bartlett, Anjou, Comice, Patrick Barry and Clairgeau. Worthy of trial are Glout Morceau, Beurre Hardy, Bosc and Howell.

Peaches: Early Alexander, Amsden June, Waterloo, Triumph, Early Columbia, Hale's Early, Mamie Ross, Lovell, Champion, Early Crawford, Early Charlotte, Tuscan Cling, Golden Cling, Muir, Late Crawford, Elberta, Globe, Fitzgerald, Salway. These varieties are named in their fruiting order. Some of the most promising of the list are the Amsden June, Early Crawford, Early Charlotte, Mamie Ross, Muir, Elberta, Globe and Salway.

Prunes: Italian. Plums: The Peach Plum and the Satsuma. The Maynard is a good home plum.

Cherries: Sweet—Royal Ann, Bing and Lambert. Sour—Olivet, Montmorency and Early Richmond; and May Duke and Late Duke for Dukes, which are especially fine for local cherries.

Walnuts: Franquette, Mayette and Meylan.

Grapes: Worden, Concord, Niagara, Delaware and Brighton.

Apricots and almonds are rarely grown, but such almonds as Grosse Tender and Languedoc should be tried.

Red raspberries: Cuthbert, Marlboro, Superlative, Antwerp.

Black raspberries: Cumberland and Gregg.

Blackberries: Evergreen, Snyder, Mammoth.

Gooseberries: The Oregon, Downing, Industry, Smith.

Currants: Perfection, Fay, Victoria, White Grape.

Strawberries: Gold Dollar, Sixteen to One, Magoon, Clark's Seedling, Autumn Bell, Marshall.

Varieties for the Umpqua Valley

The principal apples grown are the Yellow Newtown, Spitzenburg and Jonathan. Pears have been planted sparingly as yet; the Bartlett, Anjou and Comice are in the lead. As this district is very early, more of the early types of cherries, pears, apples and peaches should be grown than is now practiced. These would find a local trade throughout the Northwest.

Leading cherries are Royal Ann, Lambert, Montmorency, Early Richmond, Early Purple Guigne. The Olivet should be tried.

Of small fruits I would advise for strawberries, Gold Dollar, Everbearing, etc., while the Clark's Seedling, Magoon, Sixteen to One, etc., will thrive.

Red raspberries: Cuthbert, Marlboro, Superlative, Antwerp.

Black raspberries: Cumberland and Gregg.

Blackberries: Evergreen, Snyder, Mammoth.

Gooseberries: The Oregon, Downing, Industry, Smith.

Currants: Perfection, Fay, Victoria, White Grape.

Grapes: Worden, Concord, Delaware, Brighton. Possibly in some sections a few of the European grapes like the Muscat and Tokay will thrive.

Varieties for the Rogue River Valley

Apples: Yellow Newtown, Spitzenburg, Jonathan, Winesap.

Pears: Bartlett, Comice, Anjou, Howell, Winter Nelis, Bosc, are commonly grown. Such varieties are Glout Morceau, Patrick Barry, Beurre Hardy are worthy of trial.

Cherries: Lambert, Royal Ann, Olivet, Montmorency, Early Richmond, May Duke and Late Duke.

Grapes: Muscat, Tokay, Thompson Seedless, Worden, Concord, Delaware.

Peaches: Practically all the commercial varieties of peaches thrive in this district.

Prunes: Few prunes are grown except for local consumption, such varieties being Italian, Petite.

Apricots: Royal and Tilton are leading varieties.

Almonds: Soft Shell, I. X. L., Languedoc, Drake's Seedling; while the Texas Prolific is recommended as worthy of trial.

Varieties for Coast Counties

All varieties of small fruits seem to grow to a high degree of perfection in these coast counties. Most of the pomaceous fruits are still in the experimental stage. Locations should be chosen that are not exposed to the strong ocean winds. The Gravenstein is thought to be one of the finest apples for these sections. Only a few of our commercial varieties are growing to a fair degree of perfection.

Peaches, cherries and grapes as a rule will probably only be grown for home consumption.

Walnut in Oregon

The English walnut is found growing very extensively through Western and Southern Oregon; specimen trees and small plantings are found from Portland to Ashland. In nearly every city of Western Oregon one will find bearing trees, more especially is this true in the Willamette valley. These plantings vary from a few trees to 20 or 30 acres of young orchards; and even much greater acreage is found. These are also found growing over parts of Eastern Oregon as far as Baker.

HOW TO HANDLE AN ORCHARD IN THE ROGUE RIVER VALLEY

James Daily

There are at least three distinct types of orchard soil in the Rogue River valley, either of which will admit of a slightly different mode of cultivation from the others; but aside from the difference in cultivation the manner of handling the orchards should be essentially the same.

There is the black, sandy loam of the creek and river bottoms, the highland free soil, known as the desert land, and a heavy, tenacious soil commonly known as "sticky."

The first two mentioned require practically the same cultivation, with perhaps the one exception, that the highland soil should be cultivated to a greater depth than is necessary with the bottom land. The soil of the desert is of a very gravelly nature generally and requires irrigation to insure sufficient moisture. The "sticky" is considered one of the best orchard soils, and to this I shall confine

Rogue River Valley. Hillcrest Orchard

my further remarks, while using our 200-acre orchard as a model. This orchard has twice established a world's record in prices received for fruit in carload lots.

We do not irrigate for two reasons: First, it is not necessary, and second, we believe we raise a much better quality of fruit without irrigation.

I shall now begin with our spring work and endeavor to picture to the reader as vividly as possible every important move we make in the orchard throughout the year.

As soon as the buds begin to swell the spray rig is put into commission and practically the entire orchard given a bath of lime-sulphur for the control of scale, fungus and aphis. This done, the spray rig is side-tracked till after the plowing is finished, when it is again brought out and we begin spraying with arsenate of lead for codling moth. To be exact, we begin the first application about ten days after the petals begin to fall, giving the pears three applications and the apples four at about 30-day intervals. This completes the spraying with the exception that every other year we spray with Bordeaux mixture. We make our own Bordeaux.

The plow is the next tool to get into working order. We have our own blacksmith shop and sharpen our own plowshares, harrow teeth, etc., and do any other repair work that does not require extraordinary skill.

Plowing time with us usually comes about March 15. Although some have finished by this time, we feel there is nothing gained by plowing so early except to avert the possibility of being caught with a dry spring and not being able to get it done properly. But this gain is offset by the extra care required for early plowed ground.

We use three seven-inch one-horse plows for plowing close to the trees. The singletree is attached to the plow beam by means of a rod or chain of sufficient length to throw the horse about four or five feet from the point of the beam. This allows the horse to swing out around the lower limbs and back into line again before the plow is dragged past the tree, thus enabling an experienced plowman to steer the plow directly up to almost any tree in the orchard.

Our rule is to plow to the trees one year and from the trees the next, then turning and crossing the orchard the next two years in the same manner. This brings us back to our first starting point every four years and keeps the orchard free from high ridges and deep furrows.

Eight ten-inch plows cut out the centers unless we should get behind with our work, and then outsiders are employed to help us out.

We aim to plow from four to six inches deep and to work this up into a dust mulch by means of the drag and spring-tooth harrows. First, the drag follows the plow to level down the clods somewhat, and then the spring-tooth is put to work going over the ground in various directions, crosswise, lengthwise and diagonally. Four good animals are used on each of these rigs and the teeth set as deep as the teams can handle them. All the unbroken ground under the trees that cannot be reached by the spring-tooth is dug up with spading forks. We thus make sure that every foot of ground is being properly stirred.

After going over the orchard five or six times with the spring-tooth, or until the ground is properly broken up, we again start the drag harrows, going over the entire orchard every ten or twelve days, and when the weather is very dry and the ground cracking badly, as often as twice a week, until the pears are ready to pick.

We use the three-section steel-frame adjustable harrow. Each harrow is fitted with a spring seat on which the driver rides when the ground is dry enough to permit. The teeth are set at an angle of about sixty degrees, and with the weight of the driver to force them down they keep the dust worked up to a desirable depth.

"Sticky" dries out and cracks very quickly if allowed to settle and harden,

but if properly worked a mud ball may be dug up within six or eight inches of the surface any time during the driest seasons.

The harrows are not allowed nearer than 18 inches to the trees, hoes being used to keep the ground worked around the trees and to cut out the weeds and sprouts missed by the Kimball weeder. We aim to keep all weeds out of the orchard during the summer, and never allow them to go to seed. The trees are hoed around every twenty to thirty days.

Apple thinning begins about June 10. We thin to one in a place and from six to eight inches apart, aiming to make one thinning suffice, as we do not believe

Triple Deck Orchard Wagon

a second thinning will pay for the expense it incurs. As our pear trees generally will mature all the fruit they can be made to stand up under, we seldom have to bother about thinning them.

When picking time arrives we have lug boxes distributed through the orchard a day or two in advance of the pickers, the distributors estimating the number of boxes required for each tree and placing them accordingly. We seldom make but one picking. Ordinarily we work 12 men gathering the fruit, four on the ground and eight working from ladders. The ground men clear the lower limbs before the ladder men arrive, thus preventing much of the fruit being bruised that otherwise would be by coming in contact with the ladders. Aprons are used exclusively, and we find them far superior to the bucket or any other picking device that we have ever seen. A large apronful will fill a lug box, and with only ordinary care none need be bruised. I think I am safe in saying that three-fourths more fruit may be gathered in a day with an apron than with an ordinary picking bucket.

Two orchard wagons equipped with tripple deck and covered to shut out the sun and rain, and each holding 54 lug boxes, are kept busy hauling fruit from the orchard to the packing house, where it is graded and packed in boxes which have been built and labeled here on the ranch, and immediately hustled off to the station for shipment. Two large wagons, each holding from 96 to 100 packed boxes, are used for this purpose.

The picking, packing and shipping of pears finished, we turn our attention to the orchard again and pick up the loose rocks that have worked to the surface and then harrow it once more to close up the wagon tracks. This is done to prevent the packed ground from drying and cracking. It is rarely necessary to harrow after apple picking, for the rainfalls usually begin before we have finished picking.

The leaves have now fallen and we take up the pruning shears. We use the short-handle shear and a ladder.

The age and condition of each individual tree determines the manner of pruning it. After the young trees have been "shaped," and until they have been brought to bearing no more wood is cut out than is absolutely necessary to retain that shape, unless the tree has become stunted or weakened in some way, when enough wood is removed to restore vitality to the remaining parts. After, however, the tree has reached the age of say ten or twelve years, some of the more crowded large limbs are removed so that more new wood may be grown to take the place of the old that will be removed from time to time thereafter. For it is a well-known fact that new wood produces the better quality and the

greater quantity of marketable fruit, and that is our principal object in pruning. The problem is how much to cut out and still keep the tree in full bearing.

As to shape, we prune for a low, open head, rounding the top to somewhat of an umbrella shape. As the prevailing winds here during the growing season are from the northwest, the tendency of the young branches is to "drift" to the southeast, and unless the tree is given an "upright" training it will soon be leaning very badly. This we do by cutting off the "outside" surplus branches on the south side of the tree and leaving them on the north side, pruning out the inner branches.

We do no summer pruning as a rule, except when made necessary by the presence of blight. One man is kept busy patrolling the orchard for blight from about April 15 to August 15, cutting off all affected limbs from twelve to eighteen inches below where the infection is discernible and immediately taking these blighted limbs out of the orchard and burning them.

When the large limbs or trunk of the

Hillcrest Orchard. Showing Clean Culture.

tree become diseased we shave off the outer layers of affected bark, leaving all the healthy bark we can consistently leave. These wounds, as well as all the tools used, are thoroughly washed with a strong corrosive sublimate solution for disinfection. These trees are then watched very closely for the remainder of the season, for when the outer bark is once broken during the sap-flowing season, that tree becomes a target for every sap-sucking germ distributor that happens along. It is to prevent the accidental "skinning" of the trees and the consequent infection that we endeavor to keep the harrows at a safe distance from them.

Our orchard work is now completed for the year, but as the problem of securing and retaining intelligent and reliable workmen is no small factor in the handling of an orchard, a few remarks on this phase of it may not be out of place.

Men working by the day do not like to lose any time, and for this reason we save all of the odd jobs possible for times when it is too disagreeable to work out of doors. These jobs include cleaning and oiling harness, sorting cull fruit, repairing tools, sawing wood, painting, etc. We paint the interior of all of our outbuildings, such as barn, packing house, wagon sheds, etc., with water paint, for fire protection as well as for the sake of appearance.

We expect our men to do ten hours of reasonably hard work, but to do this they must have a good night's rest and three good meals, to supply which we provide sanitary sleeping quarters, adjacent to which are both tub and shower baths, and furnish the table with a liberal allowance of good, clean and well-cooked wholesome food. We have our own cows and chickens and the men are given all the milk, cream, fresh butter and eggs they want. The men have a reading room supplied with daily papers, magazines and other periodicals, where they can either read or indulge in quiet games, and they seem to appreciate it.

In the field, if no other place, we endeavor to apply the Golden Rule, treating the men as we would like to be treated by them were we to exchange places, and we have come to the conclusion that such treatment is a paying investment, as evidenced by the fact that it is seldom necessary to discharge a man for non-performance of duty. Of the 18 men now employed, our newest arrival has been with us about six weeks, the others ranging from that time up to two and a half years. Any of these men know what to do and how to do it—and do it—when sent out to work, without having some one along to see that the job is done and done rightly. Intelligent, reliable labor is cheap at twice the wages paid for the ordinary cross-country wanderer.

Production of Fruit in Oregon in 1912 (State Report)

Apples, bushels, 3,750,000.

Dried prunes, pounds, 18,000,000.

Plums and prunes sold fresh, pounds, 15,000,000.

Pears, bushels, 550,000.

Peaches, boxes, 1,100,000.

Cherries, pounds, 12,500,000.

Grapes, pounds, 5,715,000.

Strawberries, pounds, 12,000,000.

Loganberries, pounds, 5,500,000.

Raspberries, pounds, 3,500,000.

Gooseberries, pounds, 650,000.

Blackberries, pounds, 2,500,000.

Currants, pounds, 475,000.

Nuts, pounds, 250,000.

The commercial apple crop of the leading counties for 1912 is estimated as follows:

Hood River county, 850 cars.

Umatilla county, 700 cars.

Jackson county, 600 cars.

Union county, 550 cars.

The pear crop of the leading counties is estimated for 1912 at:

Jackson county, 250 cars.

Wasco county, 40 cars.

Douglas county, 35 cars.

Umatilla county, 30 cars.

Josephine county, 30 cars.

Wasco, Umatilla and Jackson counties are the leading peach-growing counties, with Josephine following Jackson closely.

H. M. Williamson,
Secretary Oregon State Board of Horticulture.

Production of Fruit in Oregon

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms.

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	......	5,122	3,470	9,348,490	$641,194
Strawberries	3,701	2,941	1,792	5,322,040	395,349
Blackberries and dewberries	1,307	431	717	915,744	61,066
Raspberries and loganberries	3,294	1,460	479	2,644,948	150,729
Currants	877	89	169	117,354	9,452
Gooseberries	1,465	186	203	307,395	20,893
Cranberries	17	14	6	40,864	3,527
Other berries	3	1	104	145	178

Strawberries are by far the most important of the small fruits raised in Oregon, with raspberries and loganberries ranking next. The total acreage of small fruits in 1909 was 5,122 and in 1899, 3,470, an increase of 47.6 per cent. The production in 1909 was 9,348,000 quarts, as compared with 6,646,000 quarts in 1899, and the value was $641,000 in 1909, as compared with $387,000 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total		4,583,735		4,309,232	4,423,244	$3,339,845	1,522,002
Apples	23,850	2,029,913	14,327	2,240,636	1,930,926	1,656,944	873,980
Peaches and nectarines	7,870	273,162	6,812	508,179	179,030	194,314	101,190
Pears	18,133	273,542	8,624	795,669	374,622	366,977	112,225
Plums and prunes	18,308	1,764,896	6,486	427,609	1,747,587	838,783	359,821
Cherries	17,281	223,456	9,646	313,770	181,089	269,934	65,347
Apricots	1,254	10,656	1,186	18,128	4,616	7,727	1,665
Quinces	3,317	8,102	1,730	5,216	5,354	5,140	(2)
Mulberries	7	8	12	25	20	26	(2)
Unclassified					...	......	[3] 7,774
Grapes	4,816	381,302	2,840	468,598	3,206,874	98,776	5,389,100
Nuts, total		[4] 16,902		[4] 197,050	[4] 177,632	[4] 13,208	42,980
English or Persian walnuts	1,134	9,526	4,300	177,004	79,060	8,288	6,110
Almonds	429	3,960	505	4,117	17,515	2,468	17,520
Black walnuts	261	2,024	156	3,405	69,097	1,333	(2)
Chestnuts	104	713	202	1,786	5,731	599	(2)
Unclassified							[3] 19,350
Tropical Fruits (figs)	55	149	92	340	5,486	376	550

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and figs.

[2] Included with "unclassified."

[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."

[4] Includes pecans, butternuts, filberts, French walnuts, Japanese walnuts, hazelnuts, Brazil nuts, beechnuts, chinquapins, hickory nuts and other nuts.

The total quantity of orchard fruits produced in 1909 was 4,423,000 bushels, valued at $3,340,000. Apples were the most important of the orchard fruits produced and plums and prunes ranked next. The production of grapes in 1909 amounted to 3,206,874 pounds, valued at $98,776, and of nuts to 177,632 pounds, valued at $13,208.

The production of all orchard fruits together in 1909 was 190.6 per cent greater than in 1899, while that of grapes declined. The value of orchard fruits increased from $906,000 in 1899 to $3,340,000 in 1909, while that of grapes declined from $162,543 in 1899 to $98,776 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore include some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	1,346	3.0	Gals.	89,919	64,890
Vinegar	1,329	2.9	Gals.	60,643	36,855
Wine and grape juice	317	0.7	Gals.	31,232	21,219
Dried fruits	1,615	3.5	Lbs.	10,904,713	2,818,200

FROST IN THE ROGUE RIVER VALLEY

When Frost May Be Expected and Where Frost Is Likely to Occur

In the spring it is found that during the day, that is, between sunrise and sunset, the wind blows mostly from northerly quarters. These winds are not moisture-laden as a rule, the relative humidity often being as low as 25 per cent at a temperature of 70 degrees Fahrenheit. During the night when frosts are likely to occur the winds die down altogether or change to a southerly quarter. The winds from the south are very dry and the relative humidity is often much lower during the period in which the winds come from the south. If the winds continue to blow from the northwest or westerly quarters frosts rarely occur, because these winds tend to raise the dew point, or, in other words, bring in air with a larger percentage of water vapor present. While the water vapor content of the atmosphere is high, damaging frosts cannot occur. It is only when the dew point temperature approaches the freezing point or is below it that we may expect a serious freeze. As a rule it is only on the valley floor that serious injury may be caused by low temperatures during the blooming period or some time thereafter. Even on the valley floor where there may be some slight elevation no frosts occur, while serious injury may result only a few feet below. The hillsides surrounding the valley usually escape frosts altogether, and the average variation in temperature in favor of the lands lying above the valley floor is from five to six degrees; therefore, even though a heavy frost may occur on the valley floor, the temperature may not go to freezing on the uplands. During the past season some records were made by observing temperatures on and near the ground, as well as on the roof of the Garnett-Corey building, which is 50 feet above the street level. While temperatures ranged as low as 23 to 25 degrees on the ground and four feet above it, the temperature on the roof was 32 to 35 degrees. There is at times, therefore, a difference of 12 degrees or more between the temperature on the ground and at a height of 50 feet above when taken on the valley floor.

Under usual conditions we are quite safe in saying that there may be little danger to the crops on the higher lands surrounding the main floor of the valley.

P. J. O'Gora,
Special United States Weather Observer.

Official Record of the Rainfall During the Six Growing Months for Eight Years at Medford, Oregon

	1905	1906	1907	1908	1909	1910	1911	1912
April	0.67	0.98	2.07	0.43	0.35	0.59	1.27	4.40
May	3.59	3.06	1.31	1.40	0.62	1.46	1.49	2.45
June	1.29	1.09	0.67	0.83	1.07	0.44	0.71	2.19
July	0.05	.	0.38	0.11	0.26	0.22	0.15	0.20
August	.	...	2.22	0.04	0.04			0.07
September	0.89	2.30	0.68	0.46	0.04	0.96	1.13	1.11
Total	6.49	7.43	7.33	3.27	3.38	3.67	4.75	10.42

Frost and Precipitation for Oregon

STATIONS	Length of record years	Average date last killing frost in spring	Average date first killing frost in autumn	Latest date killing frost in spring	Earliest date killing frost in autumn	Average number rainy days annual	Precipitation annual inches
Columbia Valley Group:							
Blalock	10	March 23.	November 2.	April 12.	October 16.	44	9.48
Condon	5	June 9.	September 14.	June 19.	September 5	70	11.98
Heppner	10	May 6.	September 29.	May 30.	September 3.	84	14.37
Pendleton	18	May 8	October 5.	June 24.	September 8.	78	14.08
Umatilla	7	April 14.	October 22.	April 30.	September 25	55	8.43
Weston	19	May 13.	September 24.	June 16.	September 8.	93	24.67
Blue Mt. Group:							
Baker City	20	May 24.	September 28.	June 24.	September 4.	108	12.88
Canyon City	5	May 19.	October 6.	June 13.	September 20.	85	17.23
Dayville	14	May 18.	September 20.	June 6.	August 31.	80	12.35
Joseph	19	June 15.	September 7.	July 7	August 3.	93	18.09
La Grande	19	May 20.	September 22.	June 24.	September 6.	98	19.13
Sparta	13	May 13.	September 28.	June 23.	August 31.	83	22.74
Plateau Group:							
Beulah	16	June 27.	August 29.	July 15.	August 9.	46	11.21
Burns	16	June 25.	August 26.	July 9.	August 3.	45	......
Happy Valley	10	On account of elevation, killing frosts are possible in all				80	13.73
Lakeview	25	months, but seldom occur in June, July and August.				72	17.18
Paisley	5	May 25.	September 24.	June 14.	September 10.	53	10.90
Prineville	12	June 8.	August 21.	July 5.	August 2.	44	9.04
Riverside	12	June 26.	August 30.	July 4.	August 9.	46	9.76
Vale	17	May 30.	September 9.	June 25.	August 21.	68	10.03
Hood River	.	March 31.	November 9.	April 23.	October 14.	......	......
Medford	..	April 29.	October 11.	May 6.	May 3.	......	......
Coast Group:							
Doraville	7	November 4.	April 13.	September 24.	May 18.	164	55.52
Astoria	22	December 2.	March 6.	November 1.	April 22.	187	75.35
Glenora	17	October 11.	May 10.	September 10	June 25.	171	132.81
Newport	18	December 22.	March 19.	October 19.	April 27.	181	69.84
Gardiner	19	December 8.	March 27.	November 1.	May 10.	146	79.31
Port Orford	4	Killing frosts on March 15, 16, 1906, January 13, 14, 1907.				169	92.25
Willamette Valley Group:							
Portland	37	November 16	March 16.	October 13.	May 17.	164	42.45
Salem	16	November 2.	April 10.	October 8.	May 10.	133	39.60
Monroe	12	November 1.	April 19.	September 16.	May 14.	160	51.81
Pompeii	14	Frosts occur in all months.				153	84.89
Detroit	5	September 21	May 4.	September 6.	May 17.	132	65.16
McKenzie Bridge	7	September 12	June 1.	August 26.	June 24.	172	69.84
Southern Oregon Group:							
Drain	6	September 26	April 27.	August 28.	May 10.	130	44.53
Roseburg	18	October 30.	April 15.	October 9.	May 16.	135	34.67
Grant's Pass	20	October 12.	May 6.	September 11	June 13.	106	32.20
Buckhorn Farm	11	October 16.	May 1.	September 7.	May 26.	118	68.68
Ashland	20	October 14.	April 20.	September 20.	May 18.	103	20.18
East Slope Cascade Mts. Group:							
Cascade Locks	18	November 13.	April 1.	October 11.	May 2.	160	78.87
The Dalles	19	November 5.	April 10.	September 26	May 12.	74	16.47
Warmspring	7	September 25.	May 24.	September 11.	June 14.	71	......
Bend	.	Frosts occur in all months.				71	......
Crescent	..	No records.				87	18.88
Silver Lake	..	Frosts occur in all months.				51	10.40
Klamath Falls	.	Frosts occur in all months.				46	12.54
Fort Klamath		Frosts occur in all months.				88	21.47

Climatic Characteristics of the Deschutes River Valley, Oregon

In general the climate is dry and subject to great extremes of temperature; there is an abundance of sunshine and for that reason, as well as on account of the dryness of the air, the extremes of temperature are not so noticeable as they otherwise would be. In the heart of the valley the temperatures sometimes go below the freezing point in midsummer, but they do not remain below this mark, as a rule, long enough to injure hardy vegetation; however, when a temperature of 26 degrees is reached damage ensues, and the interval between the last temperature of 26 degrees in the spring and the first in the fall constitutes the growing season for the staple crops raised in the valley. This season usually begins the middle of May and lasts until the middle of September. The prevailing winds are southwesterly, with a tendency to veer to the west, or even northwest, at times during the summer months.

EDWARD A. BEALS,
District Forecaster, U. S. Weather Bureau.

OREGON APPLE. See *Apple, Botany of.*

OREGON HORTICULTURAL LAW. See *Law.*

OVERPRODUCTION OF APPLES. See *Apple Industry.*

OYSTER PLANT. See *Salsify.*

The Ozarks

*The past two or three decades have witnessed remarkable development in the fruit industry. Much of this development has been along safe and conservative lines, but the extensive planting of orchards in regions whose natural advantages have been overestimated, or overexploited, has been too frequent. Probably in most of these instances the development of orchards has been mainly a land-selling proposition rather than a carefully planned fruit-growing project. In this expansion of the commercial fruit industry of the country the Ozark region has held a conspicuous place.

It would perhaps be difficult to ascribe to definite influences the rapid expansion of fruit culture in this region, especially in Missouri and Arkansas, during the period from 1890 to 1900. Without doubt, however, an influence which contributed largely to the early impetus in the planting of apples was the very satisfactory prices obtained in the late eighties for the abundant crops produced on the comparatively small number of trees then in bearing. This was a period when there were relatively light crops of fruit in the older apple-producing sections of the East. Once given the impetus, the rapid growth is not difficult to explain. During the years of most rapid development the fruit-growing possibilities of the Ozark region were widely advertised, not only in this country but also abroad.

The Bureau of Plant Industry of the Department of Agriculture began in 1903 a study the object of which was to determine as far as possible (1) the exact behavior of the different varieties, especially the apple and the peach, in the different parts of the region; (2) the conditions under which they attain the highest degree of perfection; (3) the suitability of each variety for the purpose intended. The final object of which was to aid in the introduction of sorts which may prove more profitable than those now being grown. This article is devoted primarily to the results of these investigations.

The soil conditions have been sufficiently described under states, in the articles entitled Missouri and Arkansas.

Climate

Climatic Conditions a Limiting Factor in Fruit Growing

In any comprehensive investigation of a given region with regard to its possibilities for fruit growing and in the consideration of all questions connected therewith relating to varieties, the climatic conditions of the region call for the most critical attention. While it may not be entirely correct to say that climate is more often the "limiting factor" in fruit production than anything else, yet it is hardly possible to overestimate the importance of climatic conditions in their relation to fruit culture.

* Condensed from Bureau Plant Industry Bulletin 275 by H. P. Gould

The more important climatic factors limiting profitable fruit production may be stated as follows:

The temperature factor.—(1) Excessively low during the dormant period, causing injury to fruit trees or buds; (2) excessively high during the dormant period, causing buds to swell and become tender, making them susceptible to injury later even by seasonable temperatures; (3) excessively low during the blossoming period, resulting in destructive frosts, or sometimes in preventing the pollen from germinating, thus making it impossible for the fruit to set; (4) destructive freezes subsequent to the setting of the fruit; (5) probably in some instances excessively high temperatures during the blossoming period, causing interference with the proper setting of the fruit.

The moisture factor.—(1) Excessive rains during the blossoming period, which may wash away the pollen; (2) rains or continuously damp, cloudy weather, which prevent the pollen grains from being properly freed for dissemination; (3) rains that prevent the activity of insects which bring about the cross-pollination which is necessary with some fruits; (4) excessive droughts, which injure trees or buds; (5) occasional precipitation in such excess as to affect the healthfulness of the trees.

The wind factor.—(1) So strong and continuous during the blossoming period as to prevent the activity of insects upon which pollinization often depends; (2) causing damage to trees or fruit at some period during growth; (3) in its relation to the evaporation of moisture and the serious results which may follow, especially during protracted droughts.

The relative amounts of sunshine and cloudiness and the intensity of the sunshine are also potent factors in their influence upon the behavior of varieties.

Data of the Missouri Portion of the Region

Mr. George Reeder, section director of the United States Weather Bureau, stationed at Columbia, Mo., has contributed a valuable digest of some of the climatological data from several points in Missouri, from which the following quotation is made:*

Notwithstanding the supposition that orchards may be more liable to injury from late spring frost at the present time because in many cases almost the entire orchard blossoms at the same time, or to the improved strain of fruit now grown [the latter statement is much in doubt, many authorities claiming that improved fruit is no more sensitive to cold than the varieties grown 30 years ago], the fact remains that the springs of the last 10 years, and particularly the last five years, averaged colder than those of the preceding 10 or 15 years, and this statement is well supported by climatological data, * * * in apparent substantiation of the popular idea that "our climate has changed." I would, however, earnestly caution the reader not to be too hasty in the conclusion * * * that the climate of Missouri is undergoing a permanent change. Meteorologists of the world generally agree, and the world's climatological records show, that the climate is practically unchangeable; that is to say, permanent climatic changes are noticeable, probably, only in geological units of time. On the other hand, the records also indicate that while weather may change from day to day or from hour to hour, there are certain changes that move in cycles or oscillations, having uncertain units of time. The cause of these cycles or oscillations is not definitely known, but it has been pointed out by one or two authorities that the wet and cool periods and the dry and warm periods on the earth appear to correspond somewhat with the periods of maximum and minimum sun spots, which in turn are thought to be due to changes in the sun's photosphere. A few students of the subject claim that these weather changes go in

* Reeder, George. "Are the springs colder now?" Monthly Weather Review, vol. 38, No. 12, December, 1910, p. 1834. See also "Late spring frosts in relation to the fruit crop of Missouri," in the Fourth Annual Report (fifty-third meeting) of the State Board of Horticulture of Missouri, 1911, pp. 119-131.

cycles of 3 years, then a longer one of about 9 or 11 years, and still a greater cycle of 30 to 35 years, the last being more clearly pronounced; but no general agreement has yet been reached regarding them.

Studies of the mean daily, mean monthly, and mean annual temperatures, while important in themselves, give us a nearly unchangeable factor, and one not particularly interesting or striking in its features.

The factor that is the most important, in my opinion, is the daily minimum temperature, which is as a rule nothing more than the lowest night temperature. The night temperatures explain the interesting cause why the crops do not grow and why the season is delayed. The days may be warm and bright, but vegetation as a rule will not flourish as long as the nights continue abnormally cold.

To the above statement regarding the importance of the daily minimum temperature in its relation to plant growth it might also be added that the duration of the minimum temperature, if it is sufficiently low to injure vegetation, is a most important factor. If a critical temperature continues for only a very short time, as sometimes happens, little or no damage may occur, while a longer period of duration may produce disastrous results.

Mr. Reeder further states:

It appears from climatological data * * * that the springs of the past 10 years experienced quite marked temperature departures from the normal. The most interesting as well as the most important question to be answered is, How long will the cold period last? Unfortunately our climatological data do not cover a sufficient length of time to enable us to work out the number of years to each cycle. While the records show periods of both mild and cold springs for the 30 years, the change during the last 20 years from mild springs to unusually cold springs is not only of marked interest to the climatologist but bears rather more serious import to the orchardists, whose earnings have been affected, and who are of course interested in the question of whether mild springs will ever come again.

In connection with the article by Reeder, data from several representative points relating to spring frosts in Missouri are presented which show that at those points the average date of the last killing frost in the spring during the years 1901 to 1910 was 11 days later than it was during the 10 years preceding 1901.

Data of the Arkansas Portion of the Region

An examination of climatological data from northwestern Arkansas during the period 1901 to 1910 shows an advance in the average date of last killing spring frost at some points but not all. For instance, the corresponding average date at Fort Smith for the years 1901 to 1908 was eight days earlier than for the period 1891 to 1900. The difference in variation between frost dates at Forth Smith and points farther north may be due to the influence of the Boston mountains in protecting the portion of the Ozarks south of them from the effects of the cold transcontinental storms which occurred during those years in their transit from west to east. Moreover, many of the orchards in northwestern Arkansas have relatively high locations, with better atmospheric drainage than those where the elevation is the same or nearly the same as the surrounding country.

Varieties Grown

On account of the large number of varieties grown in this section, discrimination is necessary in selecting sorts for discussion. Space limitations forbid them all; but as far as possible the varieties included consist (1) of the sorts which are widely grown; (2) of those now grown only to a limited extent but which appear to be of such value as to warrant more extensive recognition; and (3) certain faulty varieties which are considered likely to be planted without a full knowledge of their tendencies.

Ada Red

This variety was originated about 1890 near Springtown, Arkansas, by Mr. A. G.

Philpot, who planted the seed from which the original tree grew.

Some of the trees suggest very strongly the probability of Red June parentage. As the seed from which the original tree sprang probably came from an apple of that variety, according to Mr. Philpot's statement, the likelihood of such parentage is strengthened.

The fruit is described as medium or above in size, roundish; under color yellowish but nearly covered with red and broken stripes of purplish crimson; dots indistinct, small; flesh whitish; texture fine, tender; flavor mild subacid; quality good. In the vicinity of its origin its season is about the middle of August. During the two seasons of 1906 and 1907 the fruit was badly attacked by apple scab where not sprayed, but it is claimed that this has not usually been the case. It is said to be excellent for culinary purposes, becoming soft and pulpy after cooking a very few minutes.

There appears to be a growing demand in the Ozark region for a variety ripening at the season of Ada Red and it is sufficiently promising to warrant thorough testing in all sections of this region.

Akin *

This variety is grown in only a few orchards in the Ozark region, but it is considered one of the more promising of the sorts now little known which in recent years have been attracting the attention of fruit growers.

The tree is a strong, very upright grower. The fruit is roundish, slightly ribbed; size medium; under color yellow, washed over almost the entire surface with bright crimson; flavor mild subacid; quality very good. Season, December to April when held under favorable conditions for keeping.

In this region thus far it has not proved uniformly productive, though some of the older trees have borne heavy crops. It is quite probable that trees now 10 to 12 years old which have not as yet set much fruit may become more prolific as they increase in age.

* For a complete history and description of this variety, see Yearbook of the Department of Agriculture, 1903, p. 268.

Arkansas

Synonym, *Mammoth Black Twig.*

Grown from seed of Limbertwig or Black Twig (*Winesap*) in 1840 by John Crawford near the present town of Rhea, Ark. Not propagated prior to 1869.

The tree is one of the best, making a fine, vigorous growth, but seldom sufficiently productive to render it a profitable commercial apple even though the fruit has excellent shipping and keeping qualities.

Arkansas Black

This variety originated on the farm of Mr. Brathwait near Bentonville, Ark. It has become of some importance in a few sections of the country, but is not popular in the Ozark region. Like the Arkansas, it usually bears very small crops. Its foliage is also attacked badly by some of the leaf-blight fungi and the fruit is so susceptible to apple scab that it usually becomes entirely worthless unless very thoroughly sprayed. When it is well developed it is a good keeping apple and a good shipper.

Arkansas Pippin or Mammoth Pippin

This variety is more commonly known as the Mammoth Pippin rather than the Arkansas Pippin.

It is a large light-colored apple, ripening about the last of August or the first of September. It occasionally produces a good crop, but is not considered a heavy bearer; nor is it much prized as a commercial variety.

Beach

The original tree of this variety stood on the farm of Oliver Young, about a fourth of a mile west of Bentonville, Ark. It bore its first fruit about the close of the Civil war. The tree bears well, but the fruit, though attractive in appearance, is rather small, subject to soft rot and bitter rot, and the dessert quality is rather poor. Its chief points of merit are its lateness in reaching maturity and its long keeping qualities.

Baldwin

Though this variety is the leading commercial winter sort in the northern apple districts from New England westward to

Michigan, it is entirely out of its geographical range of adaptability in the Ozark region. It ripens or drops in August or early in September, has a soft texture, and is undesirable in nearly every particular. Fortunately, it is found in only a few orchards.

Ben Davis

Based on the relative number of trees in the Ozark orchards, the Ben Davis apple is by far the most important variety which is grown in the Ozark region. Probably from 50 to 75 per cent of the entire number of trees in the commercial orchards consist of this variety. This statement, however, does not necessarily indicate its relative value. In fact, there is such diversity of opinion in regard to its actual merits, and considered broadly in its relation to the whole apple industry, the matter is so far-reaching that it is difficult to define the position which it actually holds. Its real position may not be the one commonly ascribed to it.

On the one hand, one grower claims that the Ben Davis is the most profitable variety that he can plant, not because of the high prices for which it sells, but because of the relatively large quantity of fruit which the trees bear—or which he expects them to bear. On the other hand, another grower could not be induced to plant this variety on account of its poor dessert quality and his jealous regard for the reputation for high quality of his fruit on the market.

These two positions represent the two extremes which growers commonly take regarding this variety. It is quite probable that some intermediate position represents more accurately its real value in this region. That there is a place for this variety and others of its group can hardly be denied, though its place should be more clearly defined than at present.

As to the adaptability of this variety to the conditions in the Ozarks, there can be no question concerning its fitness, since in seasons which are favorable to the development of any variety, this one usually reaches a high degree of perfection. During the unusual climatic conditions of the past few years, however, other varieties, especially Jonathan, have borne as regularly.

The rather extravagant claims which are sometimes made regarding the high dessert quality which the Ben Davis develops in this region can not be generally accepted aside from the fact that in texture, juiciness, and in other particulars the fruit from this region is markedly superior to that grown in a region which is not within the geographical range of the variety.

The tree is generally a vigorous grower, though the foliage is often badly injured by fungous diseases. Bitter-rot and apple blotch are apt to be very serious on the fruit unless thoroughly sprayed.

Great quantities of Ben Davis apples, especially the lower grades, are evaporated in the Ozarks. They make a particularly white stock, attractive in appearance, but in dessert quality the evaporated fruit is not better relatively than the fresh fruit.

Considered in its broad relation to the whole apple industry, the growing of immense quantities of a variety which is recognized as being of such poor dessert quality as is the one in question is a matter which touches every phase of the apple industry. Any commodity of poor quality, grown in large quantities and placed upon the market for a long period of time, will injure the whole apple industry by lessening the demand for apples.

Benoni

Only a few orchards in the Ozarks contain this variety; those in which it has been observed are in Southwestern Missouri, where it usually reaches a high degree of perfection and is highly prized in its season.

The fruit is small to medium in size; color yellow, washed with mixed red and broken stripes of crimson; quality very good; season in Southwestern Missouri, July, about 10 days to two weeks later than Red June.

Though but limited observation of this variety has been possible, it is considered worthy of critical consideration by those who desire an early variety having

the size and other characteristics of this one.

Clayton

This variety is quite generally distributed in this region and occurs in many orchards, though it has not been so extensively planted as many other sorts. Unless the soil is particularly rich and deep and the trees are given good care, they make a rather poor growth and often have a stunted appearance, with strikingly light-colored foliage.

Different trees of this variety have thus far shown considerable irregularity in bearing, even where trees stand side by side in the same orchard.

Coffelt

This variety originated with Mr. Wyatt Coffelt, in Benton county, Arkansas. Though of fairly good dessert quality and a good keeper, it is only medium in size, of a dull color, and has nothing especial to recommend it.

Collins

This variety originated on the farm of Mr. Samuel Holt, near Lincoln, in Washington county, Arkansas. The tree is not a particularly vigorous grower, but is one of the most regular and abundant bearers. Under favorable conditions it colors highly and keeps well, but is of poor dessert quality.

Etris

Originated in the orchard of Mr. A. K. Etris, near Bentonville, Ark. It so closely resembles the Gano as to suggest a very strong probability of the two varieties being identical. A few orchards under this name are grown in northwestern Arkansas, but its distribution is quite limited.

Florence

The tree from which this variety was first propagated stood on a farm owned by the late W. E. Buchannan, about three miles southeast of Bentonville, Ark.

It appears to possess much merit for the Ozark region. The trees are strong, vigorous growers, healthy and with excellent bearing tendencies. The fruit is round, large, smooth and yellow, with stripes of purplish crimson. The flesh is yellow, rather coarse in texture, juicy, aromatic, and the quality is good to very good. Season for harvesting is about the middle of August, or nearly with the Jonathan. It probably does not keep as well in storage as the Jonathan.

Gano

This variety originated near Parkville, Platte county, Missouri. The farm on which it originated was bought by Mr. Gano, from whom it took its name. The Gano is a beautiful red but in other respects is so similar to the Ben Davis that we refer our readers to a description of that variety for an estimate of the Gano.

Gilpin

This variety was formerly planted in considerable quantities but is not now recommended.

Givens

This variety was originated by Mr. H. Highfill, of Benton county, Arkansas. It is of fair quality, but not recommended except in the fact that it may be picked later than most other varieties, and therefore extends the picking season. Nevertheless there is difference of opinion, and some believe it to be a valuable fruit.

Golden Russet

This variety is not extensively planted because it seems not adapted to this region. It ripens too early for winter use and does not retain the good dessert qualities of the apple grown in the Northern sections.

Grimes

The Grimes Golden is one of the important commercial apples of the northern section of the Ozarks. The fruit does not develop well and the flavor is not good in the southern section. It is harvested during the last of August and first of September, and if held for winter use must be placed in cold storage.

Hastings Red

This is a variety of the Gano type and closely resembles it. It appeared first in an orchard of Ben Davis trees belonging to William Hastings, near Benton, Ark. When the fruit of the trees planted in that orchard appeared, one tree was red

like the Gano. When he propagated from that tree by grafts about half of the trees were striped like the Ben Davis and half were a light pinkish red. He then propagated from the trees bearing the pinkish fruit and, so far as observed, the trees have all produced fruit colored like the parent. The tree has no especial commercial value, being so much like the Gano, only a little lighter in color.

Highfill

The tree was originated by Mr. Highfill near Springtown, Ark. It is a seedling originating from a Ben Davis, which it very much resembles. The tree is not as vigorous a grower as the Ben Davis.

Howard Sweet

Originated in Washington county, Arkansas. It bears large crops of highly-colored sweet apples and its merit is principally in the fact that it is a good sweet winter apple.

Jonathan

Very few varieties are more extensively grown in the Ozark region than the Jonathan, and few are grown more successfully. It is probably the most valuable of any variety now grown in this region. The tree is not particularly strong and is often quite severely attacked by twig blight. It is usually harvested about the last of August or first of September and is considered a late fall and early winter apple, but if kept in cold storage it may be marketed as late as February.

King David

This variety originated on the farm of Ben Frost, near Durham, Washington County, Arkansas. It has been widely planted in many sections of the country, but in the Ozarks is found in but few orchards. The tree is a better grower than the Jonathan, with which its fruit is more nearly comparable than any other.

Lawyer

Synonym, *Delaware Red.*

This variety is widely distributed throughout the country, but is not largely grown. The tree is a vigorous grower, but it is a light bearer.

Limbertwig

This variety is not adapted to the conditions of the Ozarks.

Maiden Blush

This constitutes in the Ozarks one of the leading early ripening sorts. The trees grow well, are not subject to disease and are productive. It ripens in this region during the last half of July and early August.

McAfee

This is a good apple, but is heavily attacked by apple scab, and drops its fruit badly.

Missouri

Synonym, *Missouri Pippin.*

This variety originated as a seedling in the orchard of Brinkley Hornsby, of Johnson county, Missouri. It has been widely planted in many sections of the country, but in the Ozarks it has proved disappointing. The fruit is of good color and fairly good in quality. Unless the tree is carefully sprayed it is subject to blight and fungus diseases. It is easily damaged by winds because the roots are shallow. In certain other parts of the country it is of more value than in the Ozarks.

Northern Spy

In the Ozarks this variety is of little or no value.

Northwestern Greening

A good apple for the Upper Mississippi and Northern sections. Not adapted to the Ozarks, where it is a fall apple rather than a winter variety.

Duchess of Oldenburg

This is a Russian variety and adapted to the North, but not especially to the Ozark region.

Red Astrachan

This is a summer variety not produced in large quantities. The tree is a vigorous grower, but does not come into bearing early. It is too acid in flavor for dessert, but is prized for cooking.

Red June

Of the summer varieties grown in the Ozarks this is probably one of the most popular. It begins ripening by the middle

of June in the southern part of this region and by the first of July in the northern part. It therefore strikes an early market in the cities of St. Louis and Kansas City.

Rome Beauty

This variety is not adapted to Ozark conditions. It may blossom well and the fruit set abundantly, but it subsequently drops its fruit to such an extent as to render it unprofitable.

Smith's Cider

This variety is more than a century old and is adapted to some sections of the country but not to the Ozark region. It is only moderately attractive in appearance and little better than the Ben Davis in quality. The fruit is subject to blotch.

Stayman Winesap

This variety was originated by the late Dr. J. Stayman, of Leavenworth, Kan. Have not been largely planted in the Ozarks and not sufficiently tested to know about their adaptability to the region.

Wealthy

The Wealthy in this region is ready for market about the first of August. It is not a vigorous grower and will not stand neglect, therefore has not done well in the parts of the Ozark region where it has been generally planted.

White Pearmain

This variety is widely grown throughout the Middle and Pacific coast states, but is not so well adapted to the Ozarks.

Willowtwig

Under certain conditions, this variety bears abundantly, but is very subject to bitter rot and is not in good favor as a commercial sort.

Winesap

Among the commercial varieties of the United States this one holds a prominent position. It probably originated in New Jersey, and the first published description appeared in 1817. It has been rather widely planted in the Ozarks, but has not given general satisfaction. It is quite apt to be unproductive and the fruit small and scabby. However, in the elevations below 1,000 feet in altitude, it assumes its normal characteristics and does well.

Yellow Bellflower

In this region it is harvested the latter part of August and the first of September and, as a rule, produces a light crop. While highly prized in some sections, especially California, it is here of secondary importance.

Yellow Newtown

While this is the best variety for Virginia and some parts of the Pacific coast, here it has poor keeping qualities and is subject to bitter rot and other diseases.

Yellow Transparent

This variety was introduced into the United States from Russia in 1870. It reaches a fair degree of perfection in a very wide range of conditions. Its strong point with most people is its early maturity. Since summer apples do not form an important part of the Ozark industry it is not recommended for this region.

York Imperial

Most of the orchards of this region have some trees of this variety, but it has not become one of the leading varieties.

For further information on this subject see *Arkansas* and *Missouri* and *Selection of a Site*, under *Apple Orchard*.

PARKER, DR. SAMUEL. See *History of Orcharding in Old Oregon*.

PARSLEY, FOR ALASKA. See *Alaska*.

Parsnip

The parsnip is a tall, biennial European herb of the parsley family (*Umbelliferae*), with a stout, smooth, furrowed stem, pinnate leaves, large terminal umbels of small yellow flowers, and a large, spindle-shaped, sweetish edible root, widely cultivated as a culinary vegetable, as well as a valuable food for livestock.

The parsnip is akin to the carrot, is grown in much the same manner, but requires a little more care in regard to the soil, its richness, looseness, etc. The land should be well manured for the best results, but if the manure is not well rotted it encourages the formation of side-

roots. Also, if the land is hard, the tap-root cannot easily penetrate the soil to any considerable depth and side-roots are formed. A well-formed parsnip is one with a thick, conical tap-root without side-roots.

Sowing the Seed

The soil should be broken up to good depth, well pulverized, and the seed sown in drills about two to three feet apart, to admit of cultivation. Seed should be sown thickly enough to allow for some seeds not germinating and the plants should be thinned to the proper distance to prevent the roots from crowding each other. The seed should be sown early in the spring, as it germinates slowly. After the plants are well started they are hardy and rather vigorous growers. The roots may be left in the ground until late in the autumn, or even over winter, for the quality is not injured by freezing. Some gather them in the autumn and pit them, others mulch them, and still others allow them to freeze, believing that freezing improves them. The trouble with this method of treatment is that it is difficult to dig them while the ground is frozen.

Marketing

There are almost as many ways of marketing parsnips as there are growers, but the best way we have ever observed is to wash them nicely in clean, pure water, trim off the side-roots and pack them in boxes, evenly according to size, and sell them by weight. The boxes should hold either a bushel or half-bushel. In the orchard districts, where fruit is packed in boxes, an apple box may be used for the bushel and a peach box for the half-bushel. If the packing is neatly done these boxes will hold a bushel or half-bushel by weight.

GRANVILLE LOWTHER

PARSNIP DISEASES

LATE BLIGHT. See *Celery Diseases*.

PARSNIP PESTS

CELERY CATERPILLAR. See *Celery Pests*.

Parsnip Louse

General Appearance

The apterous forms are pale apple green, occasionally with small red spots on the dorsum. The winged forms are green, with dark head, antennae, thorax, middle of the abdomen, tips of cornicles and leg joints. The species is recognized by the small tubercle on the posterior of the abdomen just above the style.

Life History

This is one of the most widely spread species, occurring on many hosts throughout the early spring and summer months. Due to its varied host plants it seldom becomes serious on any one of them.

Food Plants

Carrots, parsnips, celery, willows.

Natural Enemies

Especially preyed upon by the larvae of syrphid flies.

E. O. ESSIG

Paw Paw

Asimina

There are several apparent species, or at least distinctive varieties of the paw-paw. One of these species, if it may be called a distinctive species, is the paw-paw of the tropics, classed botanically as *Carica papaya*. It has usually a stem, or trunk, without branches, which bears a crest of alternate leaves, in the axils of which are born racemes of small flowers, followed by yellow fruits sometimes a foot long and containing a large quantity of black seeds. The unripe fruits are cooked like squashes but when ripe they are often eaten raw. In climates free from frost the plants are cultivated for home use as other fruits or vegetables.

Another species is grown in many parts of the United States where the climate is not too severe. It is a small tree, straight, with rather soft, brittle wood, large leaf; grows mostly in deep, rich soils along the streams, and produces an aromatic fruit from two to six inches long. The tree is sometimes grown for ornamental purposes and some improved varieties have been produced, but it seems not to have gained favor as a commercial fruit.

GRANVILLE LOWTHER

Peas

Pisum sativum

The pea is an annual plant of uncertain origin, but probably a native of Central Europe. The flowers are either white or violet colored, but the most desirable garden kinds, almost without exception, bear white flowers.

Varieties of peas are divided into three classes, those having wrinkled seed, those having round, small seed, and those having edible pods. Wrinkled seeded varieties do not germinate as well as the smooth-skinned or round sorts, nor do their germinating powers last so long, nor are they so hardy in resisting the adverse conditions of early spring. On account of the latter reason, gardeners plant the round seed first in the spring, and do not plant the wrinkled kinds until the soil is in best condition and somewhat warm. The wrinkled kinds are better in quality than the round and smooth varieties. Peas having edible pods are not popular in this country, probably because of the ease with which string beans are grown.

Culture

Peas may be grown successfully in almost any good soil; they even do well on rather poor soil. The kinds having smooth seeds should be planted as soon as the ground can be worked in the spring —even a hard freeze does not hurt the plants as they are coming out of the ground, and they will stand considerable frost when well up. The distance between the rows and the seeds in the row depends somewhat on the kinds grown. Some kinds branch out far more than others and, consequently, need more room in the row. They also vary in length of stem from a few inches to six or seven feet. The tall kinds require the rows to be five or six feet apart, while dwarf varieties are generally planted in rows thirty inches to three feet apart. The growing of tall kinds is mostly confined to private gardens, where it is customary to use brush or other material in the rows for support. Formerly, among tall varieties, were those far excelling in quality anything found among those of a dwarf habit, but recent introductions of the latter kinds have shown a great improvement in quality, until now the dwarf sorts are generally grown, even by the most fastidious. In common practice, the seed is sown about four inches deep, in rows three feet apart, putting about ten seeds to each foot of row. It is best to sow plenty of seed in order to secure a good stand. The land should be well cultivated between the rows. Unleached wood ashes or some other fertilizer rich in potash and phosphoric acid is most beneficial for this crop. As it belongs to the leguminous section of plants, it is a nitrogen producer and, consequently, does not need much nitrogen in the soil. Early peas as generally grown are out of the way in time to allow the land to be used for late cabbage or string beans. When it is desired to extend the season of table peas, successive sowings should be made at intervals of two weeks, up to the 10th of June. During the summer the vines are too liable to mildew to make late spring planting successful. The pea is distinctively a cool-weather plant and on this account it will often do well when sown in the latter part of summer for use in autumn.

The canning of peas is an important industry in some sections and could be more generally introduced to advantage. In sowing peas for canneries it is the practice in some sections to sow them with a common grain drill, leaving a path between each strip for the pickers.

Varieties

Of the many varieties only a few of the best are referred to here. For very early use, almost every seedman has a strain of smooth, round peas, which he sends out under his own peculiar name. The early sorts are generally derived from the old Daniel O'Rourke, and among them are varieties known as the First and Best, Earliest of All, and Improved Extra Early. As a rule, these should be used for first planting only, to be followed by plantings of the wrinkled sorts.

American Wonder is a very dwarf early pea of unsurpassed quality and very hardy for a wrinkled sort. A rich soil and extra cultivation are required to get

the best results from it. If only one variety is to be grown, this is perhaps the best to plant.

Stratagem. Very productive and justly very popular, having remarkably large pods filled with rich, sweet peas. It does better on light than an heavy soils.

Yorkshire Hero.—An excellent variety.

Marrowfat.—Among the most popular of the old varieties.

Champion of England. A tall-growing popular sort, of best quality, that does best when supported by brush or wire netting. Late.

Telephone.—Of excellent quality. Pods and seeds large. One of the most productive and, consequently, very popular. Late.

Bliss's Abundance.—Half-dwarf, branching, of excellent quality and very productive. Late.

Nott's Excelsior.—A new, very productive, early dwarf variety that is becoming very popular, and in some sections much preferred to the American Wonder.

Samuel B. Green,
Vegetable Gardening

English Peas

(Adapted to Southern Conditions.)

English peas are one of the best of our early garden crops, and they are grown quite extensively by truckers for Northern markets. When grown for shipping, only the dwarf, early varieties are used.

The location best adapted to this crop is a warm, rich, sandy loam. The land should be broken in the fall, though not particularly deep. Just before planting time, disk and harrow the soil until it is free from all lumps or clods.

Peas do not require an excessive supply of nitrogenous fertilizers, but some quick-acting form such as nitrate is useful in giving the plants a good start. Many growers use about 700 lbs. of cotton-seed meal per acre under the crop and follow the crop of peas with cotton or corn, which utilizes the fertilizer left from the pea crop. An application of the following per acre will give good results.

Acid phosphate (16 per cent)	400 lbs.
Nitrate of soda	70 lbs.
Muriate of potash	80 lbs.
Total	550 lbs.

The above is a 11.6-2-7 goods.

A top dressing of 100 lbs. of nitrate per acre at blossoming time proves very beneficial.

The pea crop is usually planted in double rows, the "doubles" being from 12 to 20 inches apart and the alternate spaces from 3 to 6 feet. If corn or cotton is to follow the crop, they are planted in these wide spaces, but if not the spaces can be cut to 3 feet. The double row allows the two rows to lop together and thus saves staking. Taller-growing varieties, however, need not be grown under this system, as they need staking in any event.

Peas should be ready to market about May 1st in the South, and a good crop would be 100 hampers per acre. These hampers hold about seven-eighths bushels and cost approximately 30 cents each to ship in carload lots to Northern markets. When the crop comes in early May the price is usually about $1.50 per hamper.

The variety used most in Alabama is "Alaska," though "First and Best," "Blue Beauty" and "Tait's Nonpareil" are good. For home use the medium early and late varieties should be used, as they are much better in quality, though not as early as the others. Some good varieties of these are "Gradus," "Premium Gem," "Telephone" and "Champion of England." These varieties can be planted for succession up until mid-summer and if planted late in summer a good fall crop can be secured.

One quart of seed will plant 100 feet of row.

P. F. Williams

The Pea Pack of the United States, by States, 1908-1911, as Reported by the Secretary of the National Canners' Association

STATES	1908	1909	1910	1911
	Cases	Cases	Cases	Cases
Wisconsin	2,200,000	1,878,000	1,086,000	1,520,000
New York	1,325,000	1,378,000	1,356,000	1,145,000
Michigan	492,000	373,000	261,000	259,000
Indiana	492,000	447,000	422,000	323,000
Maryland	343,000	226,000	200,000	305,000
Ohio	199,000	113,000	170,000	128,000
Delaware	211,000	232,000	299,000	192,000
New Jersey				
Oklahoma				
Utah				
Oregon				
Kansas				
Iowa	263,000	343,000	205,000	350,000
Pennsylvania				
Illinois				
Virginia				
Minnesota				
California [1]				
All other states	52,000	38,000	138,000	150,000
Totals	5,577,000	5,028,000	4,137,000	4,372,000

[1] The figures of this state on peas were omitted in the official report of 1910 because they were not complete at that time. They have since been compiled, and are as follows:

1910—210,000 cases.
1911—160,000 cases.

To prevent confusion or misunderstanding the figures of this state are given in this explanatory note.

PEA DISEASES

Anthracnose

Ascochyta pisi Lib.

The anthracnose, or pod spot of the pea often develops into a serious blight of field peas grown for canneries. The anthracnose fungus infects the seed peas so that these when planted give diseased seedlings and the consequent loss of crop.

It has been shown that by spraying with Bordeaux mixture healthy seed peas may be grown. The growth of healthy peas for seeding disposes of the problem of anthracnose. See also anthracnose of beans.

Blight

Septoria pisi West.

Produces black spots on the leaves and pods and seriously injures the vine. Most troublesome in wet weather.

Spray with Bordeaux mixture if the trouble is serious enough to make it profitable.

Fusarium. See *Watermelon Diseases.*

Pod Spot. See *Blight.*

Leaf Spot

Septoria pisi West.

Other leaf spots besides those of the anthracnose are sometimes found upon the pea and are apparently caused by another fungus. These, if giving trouble, will be controlled by the spraying for anthracnose.

Mildew

Erysiphe polygoni.

Covers the plants and pods with a white mildew. Most prevalent in wet weather and is usually only serious on the winter crop.

Dust the vines with dry sulphur at the first appearance of the trouble.

In cloudy weather spraying with Bordeaux mixture is most effective.

Powdery Mildew

Erysiphe communis Wallr.

The mildew fungus often attacks the pea and at times entirely destroys its fruitfulness. It may be known by the whitish coating produced upon the leaves and by the dark, pin-head spots of the fungus observed to be situated in these white coverings. The same fungus likewise attacks the bean. For either plant spraying with Bordeaux mixture will be found beneficial. The first application should be made promptly.

Wilt. See *Watermelon Diseases.*

PEA PESTS

ALFALFA LOOPER. See *Clover and Alfalfa Pests.*

BEAN THRIPS. See *Bean Pests.*

BEAN WEEVILL. See *Bean Pests.*

BEET ARMY WORM. See *Beet Pests.*

CLOVER MITE. See *Clover and Alfalfa Pests.*

DESTRUCTIVE PEA LOUSE. See *Aphids.*

Pea Weevil

**Laria pisorium* Linn.
(Family *Bruchidae*)
Bruchus pisorium Linn.

General Appearance

The adult beetles are about three-eighths of an inch long, brownish black in color with well-defined light spots on the wing covers and a distinct white spot on the hinder part of the thorax near the base of the wing covers. The eggs are very small (1.5 mm. long) and deep yellow in color. The larvae are yellowish in color with a dark head. The pupae are first light, gradually becoming darker with age.

Life History

The adult hibernating weevils appear in the spring and as soon as the pods are formed on the vines begin egg-laying. The eggs are thrust inside of the pod by the females, thus being thoroughly protected and out of sight. The young grubs, as soon as hatched, bore into the tender peas and remain inside, drilling out sufficient room until they are ready to emerge as adults in the fall. This is accomplished by cutting a circular hole in one side of the pea. Unlike the bean weevil, this species works only upon the peas originally attacked when green and does not continue to breed upon dried and stored seed. There is but one uneven brood a year.

*NOTE. The pea weevil greatly resembles the broad bean weevil, *Laria rufimana*, Boh.

Foods

Works upon all varieties of garden and flower peas.

Control

As the seed is infested before harvesting, control measures are of little avail, except to prevent a reinfestation by means of the seed. A thorough fumigation with carbon bisulfid is a sure way of accomplishing this.

E. O. ESSIG

STRIPED CUCUMBER BEETLE. See *Cucumber Pests.*

TWELVE-SPOTTED CUCUMBER BEETLE. See *Cucumber Pests.*

WESTERN ARMY WORM. See *Beet Pests.*

CANADA PEAS. See *Apple Orchard, Cover Crop.*

Peaches

Origin

Charles Darwin claimed that the peach was derived from the almond, and among his proofs cited the similarity of the pit of the peach to the seed of the almond in both form and chemical substance. He

Elbertas.

Experiment Farms, Ottawa.

showed further the similarity of form and habits of the trees, and claimed that in the development of the almond the pit had been improved, and in the case of the peach the pulp had been improved. It has generally been conceded that the peach originated in Persia, hence its name *Prunus persica*. Later investigations made by DeCandolle point to China as the place of origin. Wherever it may have originated it has come to be propagated in most of the temperate climates of the globe, especially in the United States. The seeds are sometimes used in the manufacture of oil instead of the seed of the bitter almond. Its leaves, flowers and bark are often used as medicines.

The Tree

The peach tree is irregularly formed with spreading branches and grows to a height of from 15 to 20 feet. While young it is a very rapid grower; but it is short lived, generally from 15 to 30 years, with the latter part of that time in a decaying condition. Its life may be prolonged by starting the head of the tree close to the ground when first planted. Then when the period of decay begins cut off the old wood, a certain proportion, say one-third each year, and allow the young sprouts to grow upon the old stock. This plan is very successful with certain varieties, provided the head of the tree has been formed at or very near the ground. The trouble with the life of the peach tree seems to be that the heart of the tree dies, leaving a decaying inner trunk. This can be obviated by low heading; for the trunk, if very short, holds its vigor much longer than if headed some distance above the ground. The same rule holds good with apples, except the apple is much longer lived than the peach. See article on *Pruning* under *Apples*.

The Soil

The soil in which the peach thrives best is a light, loose, rather sandy loam, although it is adaptable and adjusts itself to varied conditions. It requires less humus and less nitrogen than is required for apples. In fact it is better if there is not a large amount of nitrogen or humus in peach land, because they incline too much to stimulate wood growth rather than fruitage. Prof. Erwin F. Smith, Washington, D. C., on the adaptation of peaches to certain soils, says: "There are many kinds of soil in which orchards can be grown successfully. At present there are commercial orchards in New England on stony and gravelly soils of poor character; in Maryland, Delaware and New Jersey, on fertile loams and on very light pine sands; in Pennsylvania, on mountain soils derived from limestones and sandstones; in South Carolina and Georgia, on light pine sands and on stiff red clay lands derived from the local decomposition of granites; in Michigan, on rather heavy clay hills, and also successfully on loams and light pine sands, even on beach sand so light as to be blown about by the winds; in Northwestern New York, on quite a variety of clays, gravels and sands forming the old lake bottom of Lake Ontario; in Florida, on flat pine sands; in Kansas, on deep black prairie soils. On all of these soils there are now growing very successful and profitable peach orchards. In general it may be said that the peach prefers light, warm, well-drained, sandy or loamy land with a clay subsoil, although some very successful orchards have been grown upon rather heavy clays and many on deep sands. Muck soils, heavy clays retentive of moisture, and in general all wet lands and flat, frosty lands are especially to be avoided."

It might be added further that peaches are grown successfully under varied conditions of soil and climate in California, where perhaps more peaches are grown for the markets than in any other state except Georgia; in Oregon, Washington and Idaho in the volcanic ash of the hills and the alluvial soils of the valleys; in the Rocky Mountain section, and under almost all conditions except that of severe cold.

The Root

The root system of the peach is what would be called lateral rather than per-

pendicular, and as a result the moisture must be nearer the surface than is necessary for trees with tap-roots. It is more drouth-resistant than either the apple or the pear, largely because the leaf surface is not so great and there is less evaporation than there would be from a larger surface, and because of the further fact that the leaf is less porous and therefore holds the water in larger degree than the more porous leaves

Drouth Resistance

There are great differences in the drouth-resisting qualities of peaches of different varieties. There is a variety called in the United States "The Indian Peach," which is very hardy, drouth-resistant, heat-enduring, and in the hot and semi-arid climates will succeed better than many other varieties. In the semi-arid portions of Kansas this peach will look green and healthy and bear a fairly good crop of fruit when the other varieties growing in the same orchard will die for lack of water. It is believed that this variety was brought to America by the Spaniards soon after its discovery, that it ran wild in the forests and became adapted to its semi-arid environment.

The Fruit

The fruit is roundish, elliptical, ranging generally from two inches to four inches in diameter and covered with down. Its flesh is whitish, yellowish, reddish, or a mixture which sometimes combines all these colors in one. The flavor is sub-acid, the taste luscious, and as a food it is nutritious and healthful. The yellow peach generally brings the highest prices in the markets, probably because of its richness and because the flesh is usually more compact and solid, holding up longer in shipment.

Selecting a Site

In selecting a site for a peach orchard the same rules apply as in selecting a site for most other kinds of fruits. As in the case of apples and small fruits, the site should be one that is as free from frost as possible; therefore the questions of elevation, air drainage and relation to large bodies of water are important. In general, the relatively higher lands are less likely to be damaged by frost than the low lands; the lands, even though on a low altitude, may be protected from frost by habitual air currents that tend to prevent frosts. Then, too, the orchards that are adjacent to large bodies of water, especially if the prevailing winds carry the evaporated moisture across the orchard, tend to prevent frost. A northern exposure is sometimes desirable, because on the north slope of the hill, or range of hills, the site is less exposed to the direct rays of the sun and the blooming period is delayed more or less, depending on the surrounding country and the climate. Sandy soils develop the buds earlier than clay soils, yet a soil mixed with sand is the soil in which peaches succeed the best.

Climate has much to do with the successful production of peaches and no one who is wise will plant a large commercial orchard without a study of the climate, soil conditions, and an effort to discover the varieties best adapted to the place where they are expected to grow. It might seem ideal if all peach growers locate in the sections best adapted to the growth of these varieties that bring the highest prices in the markets; but this cannot be done, therefore we have to adapt in some degree at least the varieties to our locations. The tendency is always for any particular industry to localize itself into those sections where they can produce the most for the least expenditure of money and of labor. This tendency will doubtless increase more and more as industry becomes more diversified and as transportation facilities become more general. Therefore commercial peach-growing will tend to centralize into certain sections, as in the case of corn in Illinois, wheat in the Dakotas, and other sections adapted to these crops. However, in smaller degree, and especially for home use, peaches will be grown in almost all parts of the United States. Planting commercial orchards with reference to the facilities for marketing should not be overlooked. The

peach is a perishable fruit, and while experimenters are improving the varieties so that they will stand a longer shipment than formerly and improving the shipping methods by improved refrigerator car service so that they can be conveyed in good condition for a much longer distance than formerly, yet there is always some loss from long shipments. The loss is not alone in the extra price of freight paid for long shipments as compared with short, but in the fact that there are dangers of wreck, delays and gradual deterioration of fruits, the cost of which it is hard to estimate. Further, peaches that are shipped long distances must, in order to reach the markets in good condition, be picked before they are ripe enough to have developed the finest flavor. For this reason fruits shipped from the Pacific coast to the Eastern states are said to lack flavor. The great problems of the grower and shipper are concerned with discovering just the right time at which the fruit must be picked to give it the proper flavor and still leave it firm enough to reach the market without breaking down. With the discovery of methods of handling which will leave the fruit absolutely uninjured and yet be economical, and very quick transportation under conditions which bring the fruit to its destination free from bruises and decays, these difficulties will be rapidly eliminated.

Preparation of Soil for Planting

There is nothing difficult about planting a peach orchard, nor in preparing the land for planting, any more than there is in preparing the land for corn, wheat or oats. Deep plowing is always better than shallow plowing, and therefore the deeper the better for peach trees.

After plowing the land should be well pulverized by disking or harrowing, or both. Sometimes it is better to disk, harrow and drag. For instance, if the land is grassy or soddy, it should be disked to cut the sod, then harrowed to pulverize it, then if it is not fully pulverized, or if it is uneven, there is nothing better than a good, heavy drag, which every farmer knows how to make. In climates where irrigation is not practiced and where there is likely to be insufficient rainfall at any time we cannot emphasize too strongly the importance of pulverizing the surface soil in order to retain the moisture. Where irrigation is practiced the land must either be sufficiently leveled so as to run the water over all parts of the orchard, or the water must be piped to the high points where it can be distributed to every part.

If it is necessary to plant an orchard on unirrigated lands where the rainfall is inadequate, then the moisture can be increased by plowing a deep furrow and back-furrow, making a trench in which to set the trees. When the showers come the tendency will be for the surface water to drain into the trench and the roots get more than when it is scattered evenly over the soil.

If, on the other hand, it is necessary to plant in wet land, the same process of back-furrowing will make ridges on which the trees can be planted and get less moisture than on the level surface.

Planting on Old Peach Land

The question as to the advisability of planting a peach orchard on land where peaches had formerly been grown has been discussed.

It is not advisable for the following reasons:

1. There are in every orchard fungus and insect pests which attack the roots of trees, some of which may have caused the death of trees in the old orchard. These rapidly spread to the roots of the young trees, and because they are small and the number of pests proportionately large, make it difficult for the trees to survive or to make a vigorous growth.

2. The soil is likely to have become exhausted in the spot where the old tree stood. The theory has been advanced that excretions of the old tree are responsible for the failure of the new one.

However, if it seems necessary to plant a young orchard on the site of the old one, it may be done successfully by pulling out, in so far as possible, the stumps

of the old orchard, breaking the land, turning under a heavy coating of manure and growing some cover crop for a year or two. By this process the land will be rejuvenated and many of the insect pests will be exterminated.

In a few cases orchards have been grown on old sites and good trees have grown in places where old trees have stood. But this is the exception and not the rule.

Selection of Trees

On this question we would place first in importance the selection of healthy, strong, vigorous growers. We quote again from Prof. Erwin F. Smith, who has had a wide range of experience and observation:

"The selection of the trees themselves is a matter of great importance. It is not necessary that they should be very large, but the trunks should be smooth and well grown and the roots abundant and as little injured as possible. To secure these desirable qualities it is well in ordering trees to have a written agreement touching the points in question, so that inferior trees may be rejected. The roots should not be close pruned except for the removal of mangled or splintered portions, and the holes in which they are set should be of such dimensions that it will not be necessary to twist and cramp them in planting. Care should be taken that they are not set shallow—that is, on top of the earth—nor buried much deeper than they stood in the original nursery. They should not be set into hard earth, nor should the holes be filled with stones and rubbish, but with mellow earth well tramped down. Experience in the United States has shown pretty clearly that peach trees in open orchards do best on peach roots; but if the situation is low and the soil rather heavy, plum roots* may be substituted, in which latter case the trees should then be closer together, say 15 by 15 or 15 by 12 feet. In the United States peaches are not grown to any extent on espaliers or in houses.

"Judgment differs as to whether it is best to set June-budded or August-budded trees. Generally it will be found convenient to buy the trees of some reliable nurseryman, and such are usually propagated from buds set in August; but if the planter prefers to grow his own trees, and time is a matter of consequence, the seedlings should be budded in June so as to obtain a grafted top the same year.

"In the selection of trees special attention should be paid to secure those which are free from fungi and injurious insects. The greatest care should be taken that the trees are not infested by borers, scale insects, or root aphides. Unfortunately trees of this character are sometimes sent out, and orchards planted from them are sure to give trouble. In general it is best to avoid trees grown in regions much subject to peach yellows and peach rosette. In buying trees the planter will do well to deal only with nurserymen who have by honest dealing gained a well-merited reputation. It is better to pay two prices for trees of an assured character than to take as a gift trees from doubtful sources." GRANVILLE LOWTHER

Grade and Quality of Trees to Buy

Trees are graded by nurserymen in two ways: by height and by caliper. The height is measured from the point where the tree was budded and the caliper is the diameter of the trunk three inches "above the bud." The latter is the more accurate and better system of grading.

The following is an example of a system of grading according to height practiced by a prominent grower of peach trees:

First class	5 to 6 feet
First class, medium	4 to 5 "
First class, light	3 to 4 "
First class, branched	2 to 3 "
First class, whips light	1 to 2 "
June buds	12 to 18 inches

If one knows the weight and quality of the trees that a certain nurseryman produces each year, this system of grading is satisfactory; but trees from various nurserymen graded according to height often vary to a great degree in caliper and weight.

* In selecting plum stocks care should be used to secure a variety which makes a good and lasting union. The marianna should not be used for a stock.

Another nurseryman grades his trees according to height and caliper in the following manner:

Grade	1-4 to 6 feet	9/16 inch and up
"	2-4 to 5 feet	½ to 9/16 inch
"	3-3 to 4 feet	7/16 to ½ inch
"	4-3 to 4 feet	⅜ to 7/16 inch
"	5-2 to 3 feet	....
"	6-1 to 2 feet	....

In general, trees four to five feet in height will caliper five-eighths of an inch or more, but sometimes when grown too thickly in the nursery row they will not be more than seven-sixteenths to one-half inch in diameter. A tree three to four feet in height, which is well branched and will caliper five-eighths inch, is more desirable than a tree four to five feet which is of the same diameter. The ideal type of peach tree for planting out is a one-year-old tree which will caliper one-half to five-eighths inch, is well branched and about three to four feet in height. Some fruit growers prefer the largest trees which can be obtained if they are well branched. These will make a good growth if not too severely injured when dug. The large trees have a more extended root system in the nursery row, and a larger proportion of this is broken off when the trees are dug than is the case with the smaller trees. The larger trees are also more expensive to ship and require more time in pruning.

On the other hand, one should not buy the smaller grades of trees which measure one to two feet in height unless they are to be planted upon especially good soil, as they often fail to make a satisfactory growth, and it generally means an extra year of cultivation before they come into bearing. And, although a smaller proportion of the root system of small trees is broken when they are dug in the nursery, they are somewhat more likely to be injured from becoming dry in transit than larger trees, as the roots are very small and quickly dried out. In general, then, trees of a medium grade are better to purchase.

First-class trees should not only be of the proper size but free from scale, root galls, borers and peach "yellows." One-year-old trees should always be planted in preference to June buds.

MAURICE A. BLAKE,

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HOME PROPAGATION OF PEACH TREES

FRANK A. WAUGH

*The first problem in starting a peach orchard is, of course, to get the trees. They may be bought or they may be propagated on the farm where they are to be grown. Either method has its advantages and disadvantages. Home propagation has generally been undertaken either by men starting large orchard enterprises or by amateurs having small gardens. The former have had in view such advantages as reduction in cost of trees, certainty of delivery when wanted, securing trees reliably true to name, and immunity from damage which often occurs in shipment. Many of the amateurs have propagated their own trees for the sake of getting special varieties which they could not easily buy from nurseries and in order to have trees true to name, but chiefly for the fun of the work.

The home propagation of peach trees has doubtless fallen off considerably within the last few years, although it would be hard to prove this by statistics. There appears to be a growing tendency among the large orchard companies, however, to leave propagation to the nurserymen. The latter really have many important advantages in growing peach trees, such as soils especially adapted to the business, experienced workmen and all the facilities for digging and handling stock. The nursery business has been so well systematized in the last few years, errors in naming have been so largely eliminated, deliveries have so far improved and the prices of nursery stock have been reduced so near to the cost of production, that it hardly seems feasible for the fruit grower to compete with the nurseryman. Either business is a big undertaking by itself and very few men

* Country Gentleman, November 9, 1912

can hope to succeed in both lines, no matter how good their opportunities may be.

The Seed

The propagation of the peach tree begins with the planting of the seed. It must be understood at once that this seed is not intended to develop into a tree itself and reproduce its kind. The seed is simply planted for the growing of a stock which is afterward budded to the desired variety. Any sort of peach seed will do, and the home gardener going at the business in a small way need give himself very little concern in selecting his pits. It will be well, of course, if he can secure seed from healthy, vigorous trees. Experienced growers have a prejudice in favor of taking seed all from one variety, and some have especial preference for the Crosby in this connection. The two customary sources of supply for the big propagators are the canning factories and the collectors of so-called Southern "wild" seed. When peaches are canned at the canneries the seeds are taken out and constitute a more or less important by-product. They are dried, packed and sold extensively to nurserymen. These seeds vary enormously in quality. Some are very large and run few to the bushel; others are small and give fully twice as many trees for each bushel of seed; some have a high percentage of viability; others germinate very poorly.

The Southern or natural seed is collected from "wild" peach trees, mostly in North Carolina, South Carolina and Tennessee. These pits are much smaller than those from the budded varieties such as are sold from the canning factories. They therefore yield from two to four times as many trees to each bushel of seed. This is a consideration of much importance to large propagators. The seed also gives a large percentage of germination and a very vigorous, even growth of stocks for budding. Nearly all nurserymen consider it distinctly superior to the canning-factory seed. The old theory, however, that seed from a wild tree is necessarily stronger, hardier or healthier than that from the budded tree is nothing but superstition.

Care of Seed

The peach pits are bought in autumn and should be clean and dry when received. Customary practice, at least among small growers, is to bury them in a moist, well-drained soil for the winter. They are placed in holes dug in the ground of any convenient size and covered with from four to six inches of earth. The soil should be of such a character as to keep the pits moist, and the locality should be such as to prevent water from draining into the hole and covering the pits during the winter. The seeds will freeze and thaw more or less during the winter season, and this has the important advantage of cracking the hard sheels and assisting materially in the germination.

The pits are dug up at potato-planting time in the spring, are sifted out of the soil and should then be planted immediately. In case the pits are not frozen and so have not been cracked or softened they may be gently cracked with a hammer before being planted. This treatment if carefully given will greatly increase the percentage and evenness of the stand, but it is, of course, a slow and expensive job. Freezing is sometimes said to be necessary to germination, but this is not a fact.

Planting the Seed

The seeds are planted in drills from three to three and a half feet apart in order to allow for horse-cultivation. The seeds are placed in the rows from two to four inches apart. They should germinate promptly and give a good even stand. The soil should be thoroughly and evenly worked and a liberal amount of fertilizer used. Indeed, the soil should be enriched before the seeds are planted, and applications of nitrate of soda between the rows during the early part of the summer will often be advantageous. It is of the greatest importance to keep the young trees growing rapidly throughout the summer up until budding time. For this reason seeds should never be

planted except upon light, warm, well-drained, rich soil, in a high state of cultivation.

Time to Bud

The budding season may extend, according to the locality and weather, from the first of August to the first of September, and continues until perhaps the latter part of September. Whether the stocks are ready for budding or not must be determined by inspection of the stocks themselves and not by reference to the calendar or consulting the moon. The trees should be grown to the size of a lead-pencil or larger and be in a vigorous state of growth. The bark near the base of the stock should peel up easily when cut, as the bark peels from a willow at whistle-making time. The easy slipping of the bark is the critical test.

Budding Tools

The propagator now supplies himself with a suitable budding knife, with some strips of raffia and with scions in the form of budding sticks cut from reliable fruiting peach trees of the variety which he wishes to reproduce. Usually he takes with him a healthy boy with freckles on his nose. The boy will take care of the rough work and help him in other ways.

The Budding Process

The boy with the freckled nose goes ahead and rubs the branches off from the stocks for a space of six or eight inches above the ground. This work should not be done much in advance of the man who is setting the buds, as it will cause the bark to "set." The budder carries his budding sticks in a moistened sack over his back, which serves the double purpose of keeping the scions moist and cooling the budder's back against the blazing heat of the August sun. It really becomes something of a chore to creep along the ground for ten hours a day during August with one's back turned directly toward the sun. Each budding stick is a shoot of the current year's growth, usually from 12 to 18 inches in length and having at the base the diameter of a very small lead pencil. From this the blades of the leaves are clipped immediately when the stick is taken from the parent tree. The petioles or stems of the leaves are left to serve a very useful purpose in setting the buds.

The budder kneels or sits beside the row of stocks and begins his work by cutting a T-shaped incision through the bark of the stock, preferably on the shady north side and as near the surface of the ground as he can conveniently work. If the stock is in proper condition the two lips of this incision peel up smoothly from the wood beneath, so as to allow the easy insertion of the bud. The propagator then cuts a single bud from his budding stick. This little bud has attached to it a shield-shaped portion of bark and the stem or petiole of the leaf. The shield is slipped down into the T-shaped opening made upon the stock and the budder slides along to the next tree, leaving the work to be finished by the boy already mentioned, who follows after and ties in the bud securely with a strip of raffia.

These ties must be examined from time to time and should be removed as soon as the buds "take." This will usually be in one or two weeks. If the ties are not removed within a month they will begin to choke the stocks, which continue to expand in diameter rapidly at this season. The tie is cut by running a sharp knife up the stock on the side opposite the bud.

These buds should grow fast to the stocks within from two to four weeks after being set, but under proper conditions will remain dormant through the first winter. They should start into vigorous growth the following spring. As soon as their growth is assured the stocks should be smoothly cut off about an inch above the inserted bud. Care is required throughout the year to protect the bud from the encroachments of the stock. Very often suckers start and, unless they are rubbed off, quickly choke out the engrafted bud. This work requires an inspection of the entire field with considerable care from two to four times

during the early part of the growing season.

The June Buds

For some years American nurserymen have been practicing a special method of propagating the peach known as June budding. This differs from the process already described in the earlier insertion of the bud and in the different results which follow. The buds are set as early as possible in the season, which in middle and Southern latitudes means during the month of June. Of course the stocks are planted early and forced to their utmost growth in order to be ready for this extra early budding. Though the bark of the stocks does not slip so well during June as during favorable weather in August, it may, nevertheless, be handled successfully by an expert budder. Some care, moreover, is to be exercised in securing scions on which the buds are sufficiently mature for use at this time. In this form of budding it is customary to set the buds considerably higher and to destroy all but a few good leaves on the stock below the bud. As soon as the bud has grown fast the top above the bud is cut away. Occasionally this is done a little at a time, in two or three operations, in order not to give the tree too severe a check. The raffia ties have to be removed very quickly, usually within five or ten days, as the stocks are necessarily growing very rapidly at this season.

Advantage

The buds now start into growth within from two to four weeks after being set, and with a favorable season will make a growth of from two to four feet in the same year they are set. Thus we come to the most important practical advantage—namely, that we secure a merchantable peach tree one year earlier than can be done by the usual methods. These trees are universally known as "June buds." A few years ago, when there was a special fever of peach-planting, nurserymen produced enormous quantities of June buds in order to meet this special demand. At present the production of June buds is falling off considerably, partly because of reduced plantings of peach trees and partly because fruit growers generally dislike to use them. The regular one-year-old trees, propagated in the usual manner, are distinctly preferred by nearly all planters. June buds are chiefly used now in Tennessee, North Carolina, South Carolina and Georgia. In the Northern peach districts, such as Ontario and Michigan, they are virtually never used.

Dwarf Peaches

A word should be said here with regard to dwarf peach trees. Few dwarfs are known in this country, and they serve, in fact, no very important purpose. They need never be expected to assume any importance in commercial peach-growing, but a certain number of dwarf trees are desired by the owners of the small gardens. Dwarf peach trees are valuable under such circumstances and are easily propagated.

The general method of propagating dwarf peach trees is to set the buds on plum stocks. Almost any species or variety of plum will answer, but some are naturally much better than others. In Europe the Myrobalan plum is chiefly used, although St. Julian is sometimes recommended. Experience in this country shows that native American plums are usually much better adapted to this purpose. The two best dwarf stocks are the native American plum (*Prunus americana*) and the dwarf Western sand cherry (*Prunus besseyi*). Furthermore, these are the stocks which it is easiest to buy in a nursery. Peach buds are set upon such stocks in precisely the same manner as upon peach stocks. They grow very rapidly for the first year or two. Sometimes their growth even outstrips that of similar varieties on regular peach roots, and the gardener begins to wonder whether he has not been fooled on his dwarfing process. The second or third year, however, the dwarfing shows itself unmistakably and the trees if properly handled will develop low, round-topped bushes and will come into bearing one or two years earlier than standard trees of the same varieties.

Most peach growers will find it strictly to their advantage to buy their trees from some reliable nurseryman. In saying this, however, we have given the most important specifications. If one deals with a thoroughly reliable nurseryman—and this includes a great majority of the firms engaged in the business—most other matters may be referred to the judgment and advice of the man who sells the trees.

The "Home Nurseryman"

There is a strong prejudice existing among peach growers in many parts of the country favoring locally grown nursery trees. This prejudice is particularly strong in the Northern states. It is doubtful whether it has any foundation whatever. Experience seems to show conclusively that the best trees will make good growth regardless of where they spent their infancy. Conditions in the nursery trade are such at the present time that a large majority of all peach trees are grown in the Southern and South-Central states. These are distributed to all parts of the country, and very often the buyer who supposes he is getting Northern-grown trees simply because his bill is made out on a Northern letterhead is really planting stock which grew in Alabama. The only advantage of buying trees from a local nursery is gained by minimizing the possibilities of injury in transit. A good many trees are carelessly packed and, when delayed during long freight shipments, dry out and are thereby seriously damaged. This danger is, of course, reduced by buying trees near home. There is, moreover, some satisfaction in dealing with a nurseryman who is one's own acquaintance, particularly if it so happens that the nurseryman is an old and trusted neighbor. These considerations need not be overlooked, but at the same time it is not necessary to maintain that such home-grown trees are intrinsically superior to those grown a thousand miles farther north or south or east or west.

Year-Old Trees Desirable

Peach trees are planted when they are one year old. They are usually dug in the nurseries in the fall, sorted, graded, put into bundles and heeled in or placed in cold storage. Sometimes they are left standing in the nurseries and are dug early the following spring immediately before transplanting. In any case the important point is to see that they come through the winter in good condition. If they are frozen while standing in the nursery rows, or if they dry out in the trenches or in the storage house, they will come to the planter with distinct evidences of these injuries, usually in the form of blackened bark. Sometimes the bark is dead and will slip off the tree when pinched by the fingers. All storage damages of this sort are serious, and trees of this kind should be refused.

A few growers still prefer a two-year-old peach tree, but in most cases it is safe to say that such preference indicates a distinct ignorance of the business. It is the opinion of nearly all fruit growers that any peach tree more than one year old is entirely worthless for planting. The June buds are here included as one-year-old trees, but as a matter of fact they are only half a year old.

Pruning the Peach

Experiments conducted by J. C. Whitten, of the Missouri Experiment Station, to determine the best method of pruning peach trees, have yielded results which may be summarized as follows:

1. Under normal conditions, when peach trees have passed the winter safely and promise to produce a crop of fruit, they should be pruned each winter by cutting back the main limbs, so as to leave one-half to two-thirds of the new growth which contains the fruit buds.

2. When the fruit buds have been winter-killed the opportunity may be seized to cut back the main limbs more severely, thus securing more compact trees and avoiding the formation of long, straggling limbs which the trees have a tendency to form if they are not cut back.

3. The amount of cutting back depends upon the extent to which the trees have been injured.

4. If the fruit buds only have been killed and the wood of the tree is unin-

jured, trees of compact form, if they have been annually pruned, should have their main limbs shortened so as to leave only a few inches of the new wood. If, however, the limbs are getting long and straggling they may be cut back into two or even three-year-old wood. Before severe cutting is done the grower should be certain that there are not enough live buds left to produce fruit. The peach sets such an abundant quantity of fruit buds that if a small percentage of them have escaped injury there may still be enough to produce a paying crop of fruit.

5. When the winter is so severe that not only the fruit buds are killed but the wood of the tree is badly discolored, the trees may be invigorated by cutting them back quite severely. The following is a summary of results of pruning peach trees during the severe freeze of 1898-9:

6. Peach trees which were not pruned, or in which only a part of the new wood was removed after the severe freeze of 1898-9, started into growth first in spring, and for two weeks after growth began they appeared to be in more vigorous condition than did pruned trees.

7. This apparent vigor of trees that were not severely pruned was only temporary, however. Some of them died a little later and none of them made satisfactory growth throughout the season. They seemed to have used up all their energy in making a start. At the close of the season they had made but little new growth and this was confined mainly to the tops of the branches, the old limbs and trunks containing only dead twigs. Their annual layer of new wood was very thin and some of their roots died.

8. Trees of bearing age that were cut back so as to leave only the trunk and bases of the main limbs died in some cases, and where they did live, their growth was unsatisfactory, many of the sprouts starting from the unreliable seedling stock below ground.

9. Trees of bearing age which were cut back into two-year-old wood in case of young trees, and to three or four-year-old wood in older trees, thus leaving stubs of the main limbs from three to four feet long, made the best growth. They made from six to nine feet of new growth and entirely renewed their heads during the following season. They also developed a good layer of new wood on their trunks and formed a good crop of fruit buds.

10. In the case of two-year-old trees, those that were cut back so as to leave the trunk and spurs of the main branches two or three inches long did best and made fine heads.

11. One-year-old trees that were cut back nearly to the original bud and had a single sprout trained up during the growing season made fine trees.

12. The principal growth took place near the extremities of the parts of the tree that were left after pruning. Trees that were cut back into more than four-year-old wood failed to grow at all in some cases, showing that in very old wood the buds are too dormant to be easily started into growth. The amount to cut away in renewing winter injured trees requires good judgment in choosing between leaving too much wood (which results in weak growth and too high heads) and cutting back too far into old, dormant wood that will not start new limbs.

13. Experiments to determine the best time to prune showed that trees that were pruned any time after the severe cold spell up to the time the buds began to start in spring grew equally well.

14. Good cultivation is of more than usual benefit to peach trees during the spring and summer following severe winter injury.

Pruning When Fruit Buds Have Been Killed

Occasionally the fruit buds of the peach are killed by a severe winter. As soon as the cold spell is over it is easy to tell whether or not the buds are injured by cutting through them. If the pistil in the center of the bud looks fresh and green the bud is all right. If the pistil looks brown and shriveled, leaving a dark spot in the center of the bud, the latter is dead. Usually some of the buds winter-

kill. It is necessary then to examine a good many buds on the different varieties to make sure whether or not enough buds are left uninjured to produce a crop of fruit. Almost every winter some one reports that the peach buds are all killed because he found upon examination that some of the buds were dead. One should guard against assuming that the peach crop is ruined because he finds that the first few buds he opens are dead. It is necessary to thoroughly examine a number of trees of all the different varieties. If, however, one finds that the fruit buds are killed, it is well to seize upon the opportunity to cut back the trees somewhat more severely than usual. If the trees are getting tall and straggly they may be shortened back somewhat and thus gotten into a more manageable form. The amount to cut back depends upon the shape of the tree and whether it is high or low. If the tree has been well pruned every winter and is compact and low it may be best to cut so as to leave short spurs of the new wood. If the trees have never been pruned, or if they are getting long and stragling, and if the new growth is short and weak they will make stronger growth and a better crop of fruit buds for the next season if they are cut back somewhat severely. In such cases the main limbs may be cut back into two, three or sometimes into four-year-old wood. One should, however, be careful not to cut back into wood that is so old and dormant that it will not form new branches the following summer. If the bark looks bright and smooth it will generally put out new limbs. If it looks dull colored and rough the wood at this point may be too old to make new growth. Usually the limbs may be cut back to some vigorous side branch, a spur of which may be allowed to terminate the limb, just below the cut. Where the trees are cut back thus severely the small, weak twigs along the trunk of the tree and on the bases of the shortened limbs should be cut off close to the point of attachment.

Of all our orchard trees the peach stands in greatest need of regular pruning. Not only should peach trees be pruned every winter but they should be cut back more severely than any other of our fruit trees. In order to understand the full import of this statement it will be necessary to keep in mind the habit of growth of the peach as compared with some of our other fruit trees. The fruit buds of the apple and pear are mostly borne on old, short spurs, attached to the older limbs. These fruit spurs of the apple and pear lengthen but little each year. The fruit then is mostly borne in the body of the tree instead of on the new growth at the extremities of the branches. On the contrary, the fruit buds of the peach are borne chiefly on the long whips of new growth which is most abundant at the extremities of the limbs. In order to secure an abundant crop of peaches it is necessary to so treat the trees as to secure an abundant new-wood growth the year before the peach crop is expected. Let us see what this treatment consists of.

If the peach tree is allowed to go unpruned it will make comparatively vigorous wood growth while it is young, and will produce a few good crops of fruit. The new-wood growth is mainly produced at the extremities of the wood which grew the previous year. Every year then, the new wood, containing the fruit buds, is farther and farther removed from the main trunk of the tree. Wood growth becomes weaker and weaker each year. The twigs in the interior of the tree begin to die, leaving long, straggling main limbs, which are bare of fruiting wood except at their extremities. These fruiting twigs are weak and so far removed from the trunk of the tree that the limbs are liable to break down if a crop of fruit is produced. Furthermore, these long, bare limbs and the unshaded trunk of the tree are liable to injury from sun scald. Gathering the fruit from these high limbs is expensive, and such fruit as may be produced on such weak growth is of inferior quality.

The object of pruning is to avoid the undesirable form of unpruned trees just described. In place of long, straggling limbs it is desirable to secure low, com-

pact trees in which the fruiting wood is kept as near the trunk of the tree as possible. In order to accomplish this it is necessary to properly shape the trees from the beginning.

Summer Pruning

Summer pruning is not a common practice among peach growers in general, but it is a very beneficial and profitable operation in young orchards. Peach trees set upon good soil and thoroughly cultivated will make a very rapid growth the second summer.

Some of the leading shoots will commonly make a growth of from five to six feet if allowed to develop unchecked, especially upn the better sandy soils. Where such a growth takes place the side branches upon the leaders are often poorly developed and the tree has really grown out of bounds. A tree will also frequently develop too many of these long leading branches besides some smaller shoots, commonly termed "suckers," and the top of the tree becomes too dense and thick. These "suckers" and undesirable branches develop at the expense of the desirable ones by shading and otherwise interfering with their growth. Such a tree will require severe pruning the following spring to get it into proper form. A too severe winter pruning is what we wish to avoid in young peach trees as it promotes vegetative growth and delays fruit production. Summer pruning has the opposite effect of winter pruning, and instead of forcing out still more vegetative growth its tendency is to check the tree and to promote fruit bearing.

Perhaps the greatest advantage of summer pruning is in training irregular trees into a better form. An orchard may be made to appear very uniform by a proper summer pruning of irregular individual trees.

Objects of Summer Pruning

The objects of summer pruning peach trees the second season may be summarized as follows:

To improve the form of the tree.

To remove "suckers" and undesirable branches which tend to make the head or top of the tree too dense.

To remove the necessity for too severe winter pruning.

To encourage and induce fruitfulness.

Trees which are making a one-sided development or an irregular growth can be trained into better form by a proper pinching back of the leading shoots in summer ("pinching" or "heading back" are terms used to designate the cutting or pinching off of the tips of growing shoots).

Trees which tend to make too upright a growth at the expense of side branches can best be induced to make a more spreading symmetrical growth by summer pruning. A too spreading type of growth may also be made more compact by a pinching back of the leading branches which tend to develop in a too horizontal or drooping position.

This phase of summer pruning, the *pinching or cutting back of the tips of leading branches*, tends to make a tree more dense and compact, because it forces a stronger development of the side branches.

Summer pruning, then, may be said to consist of two distinct operations: the thinning of the new growth, including the removal of any water sprouts or suckers, and the pinching back of leading, rapidly-growing shoots.

Both operations are usually necessary in summer pruning peach trees that are growing rapidly the second summer. The simple pinching back of the tips of the most vigorous shoots results in making the tree more dense and compact, which is the exact thing we wish to avoid. *In general, then, where pinching back is practiced some thinning of shoots is also necessary.* The exception may occur with a very open spreading type of tree with but little growth in the center, where the pinching back will simply check the sprawling or very upright form of the growth without causing the center to become dense.

Trees which are making a weak growth should never be summer pruned, as pruning tends to check them.

MAURICE A. BLAKE.

New Jersey Agricultural Experiment Station Bulletin 231.

Pruning to Overcome Winter Freezing

During the winter of 1909-10 the Yakima valley had a long period of exceedingly cold weather, the mercury falling as low as 20 degrees below zero. Many of the peach trees were so frozen that it was a problem with the growers as to what they should do with them.

Three methods were followed: That of cutting the trees down to the ground, or nearly so; "dehorning," or cutting back the main limbs to within six inches or a foot of the trunk; and lastly, the more moderate method of cutting back heavily but not so heavily as to reach the "dehorning" stage. Still others dug up their trees, and either planted other fruits such as apples or pears in place of the peaches or planted new varieties of peaches. The writer watched these experiments with much interest, and at the same time pruned his own orchard, cutting off all branches that seemed to be injured by the freeze. The conclusions were as follows:

1. Old trees that are beginning to decline, if frozen severely will not pay for rejuvenating, and it is better to dig them up.

2. In young trees, the "dehorning" method was not necessary.

3. It was found better not to prune until the buds started, and then to cut off all dead branches.

4. Cutting down to the ground did not prove satisfactory as compared with the less radical treatment.

Trees that were in vigorous health are more resistant to cold than those less vigorous. Therefore, fertility of soil, plenty of water, or whatever tends to promote vigor, gives greater resistance to cold.

It is possible in the irrigated regions to water too late and keep trees growing until so late a period that the new wood does not sufficiently mature to resist a heavy freeze.

GRANVILLE LOWTHER

Top-Working Bearing Peach Trees

With the rapid growth of the peach industry many varieties have been planted in large quantities that are undesirable for commercial purposes or ill-adapted to the regions in which they are located. There are also many orchards more than ten years old, with trees still vigorous, but of varieties that are no longer equal to the newer commercial sorts. To sacrifice the orchards by cutting them out means a loss of labor and capital already invested, but to leave the trees unchanged continues an unproductive investment. It is possible to top-bud these orchards with better varieties, and it may be desirable from the commercial standpoint to do so if the trees have been given good care, as new tops may be formed that will produce good crops in three or four years.

The budding may be done either in June or in the fall, the season depending on the locality and the convenience of the grower. The buds may be inserted on the main branches if the diameter of the latter within six or eight inches of the trunk is not over one and one-half inches. On larger trees it is not advisable to bud the main branches, but new shoots in which the buds can be inserted may be provided near the trunk of the tree by cutting off the main branches within one and one-half to two feet of the body, and by thoroughly cultivating the soil after the heads are removed.

In preparing the tree for fall budding it is often possible to pick the fruit, then cut back the top, and insert the buds in three to five of the main branches near the trunk, the distribution of the buds having regard for the form of the future top. In large trees the cutting back is done the preceding winter or spring to provide the new shoots for budding. In the South, however, where fruit is harvested earlier in the season, it is possible to take the crop, remove the top, and then by frequent cultivation provide new shoots on the larger branches that can be budded in August of the same year.

As soon as the new buds start into growth the old top should be entirely removed and the branches bearing the buds cut back close to the bud. The new shoots that grow on the old branches should be kept off, and the new head formed in accordance with the grower's

ideal for a top. It may be advisable to head in the shoots of the new top during the first summer to stock them up and prevent long, slender, weak branches. The ends of the old branches should be painted with red lead to prevent the entrance of fungi and bacteria which cause their decay. If care is exercised in all of the operations, the new top may bear profitable crops for many years.

G. HAROLD POWELL,

U. S. Department Agriculture Yearbook, 1902.

Cultivation

The peach tree needs cultivation the same as any other farm crop, and for the same reason. Cultivation keeps down the weeds that would, if allowed to grow, compete with the trees for food. Cultivation pulverizes tne land and retains the moisture. Cultivation aerates the soil and makes plant food that is in the soil available.

The land should be plowed in the spring or the autumn, depending upon conditions. If there is a lack of moisture, fall plowed land will hold the winter snows and rains better than if the plowing is delayed until spring. But the plowing, whether in autumn or spring, should be shallow, because the roots of the peach tree form laterally near the surface, and deep plowing will injure them. After the first plowing, it is a matter of simple cultivation with cultivator or harrow, or both, the same as for corn or cotton, or for other trees.

Intercropping

The question of intercropping until such time as the peach trees come into bearing, is a controverted one. The answer depends largely on the conditions. If the land on which the orchard is growing is rich, there can be no reasonable objection to growing some other crop while the trees are coming into bearing. If the land is poor, intercropping robs the soil of food which the trees will need later to mature the best quality of fruit. However, this may be supplied by the use of barnyard manure, and if this is added to the land to an amount equivalent to that which is taken off by the crop, the intercropping improves the soil. It is a mistake to suppose that cropping injures land, provided as many tons of fertilizing substance is put on as the crops take off.

The process of intercropping could be kept up for years with profit to the grower, provided the land were properly fed, and provided the trees did not interfere with the crops. It is mainly a question of feeding the land.

GRANVILLE LOWTHER

Cover Crops

It will prove to be both economical and profitable to sow a cover crop in the peach orchard, and soils deficient in nitrogen and organic matter may be much improved by such practice without great expense. And where trees are likely to make a late growth in fall because of liberal quantities of moisture and available plant food, a cover crop can be chosen and planted that will consume much of the available plant food and reduce the moisture content of the soil; this will check the growth of the trees and result in a better ripening of the wood for the winter season.

A cover crop may also prove to be beneficial in preventing washing of the surface soil, leaching, alternate freezing and thawing and winter injury to the bark of the main root near the surface of the ground.

Where the soil of the peach orchard is deficient in both nitrogen and organic matter, a cover crop of crimson clover or hairy vetch is to be recommended. Crimson clover becomes almost an ideal orchard cover crop where there is sufficient moisture in the late summer to insure good germination and where it does not winter-kill. Hairy or winter vetch often gives better results than crimson clover where there is lack of moisture in the late fall, and usually passes the winter with but little injury. The vetch will continue to make growth during quite cold weather, which is often an advantage under orchard conditions where it is always desirable to plow early in the spring.

Fifteen pounds of crimson clover seed to the acre should be sufficient to ensure a good cover unless the soil conditions are unfavorable.

Thirty to 35 pounds of hairy vetch seed should be used per acre to secure a good stand of that crop. The seed of the vetch has been rather high in price in past years, but is becoming cheaper and is a profitable cover crop.

The thoroughness of the cultivation of the orchard during the summer has an important bearing upon the success of the cover crop. Where the cultivation of the orchard is wholly or partly neglected, or where a crop is grown between the trees, considerable moisture is lost by evaporation, and when the cover crop is sown in the late summer it fails to find favorable conditions for growth. Thorough cultivation during the early summer does much to insure a maximum cover crop.

The cover crop must be plowed under very early the following spring to conserve the moisture in the soil for the benefit of the trees. It is therefore necessary that the cover crop make considerable growth in the late summer and fall, otherwise full benefit will not be secured from it.

Crimson clover and hairy vetch should be sown in the young peach orchard about July 15th to 20th. If the planting is delayed much later than this the best results are not likely to be secured.

Cow peas are sometimes recommended as a cover crop for the peach orchard, but are usually less satisfactory than crimson clover or hairy vetch. A cover crop should not be planted much before July 15th, as the stopping of cultivation allows the soil to dry out too early, and cow peas planted late often fail to make a good growth in the orchard, especially in dry seasons. The first killing frost also stops their growth, the plants die and there is loss of nitrogen before spring. The expense for seed is also greater than for a cover crop of crimson clover.

Upon rich, moist, loamy soils, where the trees are likely to make a late growth, a cover crop of oats and vetch or oats and crimson clover can be recommended. The oats grow rapidly and soon take up much of the available plant food and reduce the soil moisture, which checks the growth of the trees and causes a better ripening of the wood. Where the soil is moist and well supplied with plant food in late summer the legumes cannot be expected to assist in checking the growth of the trees.

When oats are used as a cover crop with vetch or crimson clover, three or four pecks of oats to 25 pounds of vetch or ten pounds of crimson clover is sufficient. The presence of the oats often protects the clover and causes it to winter in better condition, but it attracts mice and rabbits, and damage to the trees should be guarded against.

The importance of plowing under the cover crop early in the spring cannot be overemphasized. Where a crop of crimson clover is allowed to grow for several weeks in the spring, it dries out the soil rapidly, so much so that in some instances the soil gets so dry and hard that plowing has to be delayed until after a rain; and where a large amount of green matter is plowed under late in spring, it does not decay and become available to the trees for some time, and the stimulation comes too late in the season for the best effect.

MAURICE A. BLAKE,
New Jersey Agricultural Experiment Station,

Moisture for Peaches

A far more important factor than food, for the peach or for any fruit, is drink. Liebig's "Law of the Minimum," according to which the yield of any crop is limited by the amount of one constituent of food, is now applied to all of the factors affecting the growth of plants. When applied to the fruits of New York it will be usually found that water is the limiting factor. One cannot do better than to quote several authorities as to the importance of moisture in growing crops.

King* states: "There are very few fields upon which crops of any kind, in any climate, can be brought to maturity with the maximum yields the soils are capable of producing without adopting means of saving the moisture."

Hilgard† holds that "under ordinary

* Physics of Agriculture, p. 181, by F. H. King, Madison, Wis. 1901.

† Soils, p. 193, by E. W Hilgard, New York 1906.

conditions of culture, and within limits varying for different soils and crops, production is almost directly proportional to the water supply during the period of active vegetation."

Whitney‡ claims that the moisture supply in the soil is the only important factor to be regarded by the cultivator in most soils, all other factors being, in general, provided for naturally.

A generation ago Johnson§ wrote: "It is a well-recognized fact that next to temperature, the water supply is the most influential factor in the product of a crop. Poor soils give good crops in seasons of plentiful and well-distributed rain or when skilfully irrigated, but insufficient moisture in the soil is an evil that no supplies of plant food can neutralize."

The trend of this discussion is obvious. The peach grower must use all possible means to provide water for his trees in the dry summer months. After having selected land naturally retentive of moisture or having a supply in the subsoil, making sure that the drainage is good, all that can be done is:

First: Supply organic matter to make the soil more capable of holding water.

Second: By continuous cultivation conserve as far as possible the rainfall.

1 Circular No. 15, N. Y. Experiment Station.

Laying Down Peach Trees for Protection of Buds

Colorado Method

The area of successful culture of the peach can be greatly extended if a practical means of protection against severe winter cold and late spring frosts can be found. The Colorado station has recently called attention to the successful employment in that state of the method of laying down and covering peach trees in winter. The method as practiced in Colorado apparently does not differ essentially from that tested by Prof. S. T. Maynard at the Massachusetts Experiment Station as early as 1886 and during the succeeding years, except that in the Colorado method irrigation water is used to soften the soil so that the trees may be laid over without any special training or pruning of the roots. The Colorado method, as described by Professor Paddock, is as follows:

"Yearling trees are set in the spring and they should be laid down the first winter, repeating the process each season during the life of the tree. In this instance no attention is given to training or placing the roots. As soon as the trees have shed their leaves and the wood is well ripened they are ready for winter quarters. * * * The first step in the operation consists in removing the earth from a circle about four feet in diameter around the tree. When sufficient trees have been treated in this manner to make the work progress advantageously, water is turned into the hollows. After the ground has become saturated the trees are worked back and forth and the water follows the roots, loosening the soil around them so that they are pushed over in the direction that offers the least resistance. When treated in this manner the trees go over easily and with comparatively little injury to the root system—that is, providing the trees have been laid down each year. It is difficult to handle old trees in this manner that have never been laid down, and usually it will not pay to try.

"After the trees are on the ground further work should be delayed until the ground has dried sufficiently to admit of ease in walking, and in the handling of the dirt. The limbs may now be brought together with a cord, and so lessen the work of covering.

"After experimenting with many kinds of covering, burlap held in place with earth has proved the most satisfactory. The burlap is spread out over the prostrate tree top, taking special pains to protect the blossom buds from coming in direct contact with the earth covering. A light layer of earth is now thrown over the tree and the protection is complete.

"The critical time in growing peaches by this method is in the spring when grow-

‡ U. S. Department Agriculture, Bureau of Soils, Bulletin 22, 1903.

§ How Crops Feed, p. 216, by Samuel W. Johnson, New York : 1870.

ing weather begins. Close watch must be kept to see that the blossoms do not open prematurely, or that the branch buds are not forced into tender, white growth. When the blossom buds begin to open, the covering should be loosened so as to admit light and air, but it should not all be removed. More of the covering should be removed as the weather gets warmer, but the blossoms must be exposed to the sun gradually.

"Air and light are, of course, necessary for proper fertilization of the flowers, but after this process is complete and the fruit is set, all danger from the weather is considered as being over. The trees are usually raised about the middle of May at Canyon City.

"Raising the tree is, of course, a simple task. The ground is again watered and when wet enough the trees are raised. To be sure, trees that have been treated in this manner will not usually stand upright unsupported. Consequently, they are propped up at an angle—usually two props being required to keep the wind from swaying them."

Professor Maynard found that when the trees were covered too closely with soil the buds were killed by heating, but when covered with mats and other light materials a large percentage of the buds were preserved. In some comparative tests made by him about 50 per cent of the buds of unprotected trees were destroyed while only 10 per cent of those of protected trees were killed. Many of the trees used in Professor Maynard's experiments were more than ten years old.

Hardiness in Peaches

Possibly the greatest problem the peach grower has to face is how to avoid or check injury from freezes and frosts. The problem is not insurmountable; for here and there varieties and orchards are wholly uninjured, and possibly adjoining others partly or wholly killed. What conditions of the trees, of the soil, or of the care, make the difference? A few years ago the writer sent several hundred circular letters to peach growers in Michigan and New York asking for information on this subject. The following is a brief summary of the answers: The peach must have a warm, well-drained soil to secure the greatest possible hardiness inherent in the species. Either extreme of moisture—excessive wetness or excessive dryness—gives favorable conditions for winter-killing Young trees suffer most in severe winter freezes. The wood of some varieties is more succulent than that of others, making such sorts susceptible to cold. Early and Late Crawford are most succulent in growth, while Chair's Choice, St. John, Niagara and Surprise are less succulent. The small-growing varieties with compact heads are hardier than the free-growing sorts with large heads. The following are the most compact growers: Hill's Chili, Crosby, Gold Drop, Barnard, Triumph, Wager and Fitzgerald. Trees are more likely to suffer from cold if unthrifty than if thrifty. Late fall growths are very susceptible to winter injury in both wood and bud. Peach growers in the two states hold that the most effective treatment of their orchards to avoid winter injury is to sow cover crops, holding that they protect the roots from cold, cause the trees to ripen thoroughly, and assist in regulating the supply of moisture. Nearly all growers in both states prefer low-headed trees, claiming that both buds and branches are more often injured in high-headed trees. The testimony secured was for most part unfavorable to windbreaks.

The five varieties of peaches most hardy in wood are: Crosby, Hill's Chili, Stevens Rareripe, Gold Drop and Elberta. The Crawfords are considered most tender in wood. The five varieties of peaches most hardy in bud are Crosby, Hill's Chili, Triumph, Gold Drop and Stevens Rareripe. The five most tender in bud are the two Crawfords, Chair's Choice, Reeves Favorite and Elberta.

Circular No. 15, New York Agricultural Experiment Station.

Dates for Picking Peaches in Yakima Valley.

VARIETY	Time picked in each district, as shown by the following:					Color inside flesh
	White Bluffs, Hanford and Kennewick	Parker and Donald	Zillah, Granger, Sunnyside Grandview and Prosser	North Yakima	Selah and Naches	
Admiral Dewey	7-19 to 8-13	7-26 to 8-14		7-24 to 8-10		Yellow
Alexander			7-18 to 8-19	7-16 to 8-16	8-29	White
Alton	7-19 to 8-9	7-26 to 8-12	8-10 to 8-21	7-30 to 8-5	8-14	White
Arp Beauty	7-19		7-18 to 7-23	8-6 to 8-31		Yellow
Belle of Georgia	8-3 to 8-30	8-9 to 9-12				White
Bernard			8-20 to 8-27			Yellow
Carmen	7-20 to 8-23	7-27 to 8-19	7-31 to 8-28	7-30 to 8-28	8-10 to 8-23	White
Champion	8-3 to 8-26	8-9 to 8-14	8-13 to 8-28	8-6 to 8-30	8-8 to 8-28	White
Charlotte				7-26 to 7-29		White
Columbia		8-9	8-24	8-17		White
Crosby	8-22 to 8-23			8-18		Yellow
Early Crawford	7-23 to 8-23	8-2 to 9-9	8-8 to 8-29	8-9 to 9-3		Yellow
Early Elberta	7-17 to 8-6		8-6 to 8-12			Yellow
Early Rivers	7-19		8-2 to 8-8			Yellow
Elberta	8-13 to 9-4	8-17 to 9-4	8-22 to 9-11	8-18 to 9-28	8-28 to 9-28	Yellow
Emma				8-14	8-22	Yellow
Foster	8-10 to 8-25	8-9 to 8-25	8-20 to 8-30	8-18	8-28 to 8-29	Yellow
Golden Cling			8-21			Yellow
Greensboro				8-6 to 8-13		White
Hales Early	7-20 to 7-30	7-16 to 7-31	7-16 to 8-2	7-16 to 8-16	8-29	White
Indian Cling				8-21	8-28 to 8-29	Red
Krummel October		10-6		10-2		Yellow
Late Crawford	8-23 to 9-3	8-24	8-21 to 9-11	8-29 to 9-5	9-10	Yellow
Lemon Cling				9-21		Yellow
Lovell					9-11	Yellow
Malta	8-20 to 8-25			8-18		Yellow
Mam. Heath Cling	7-20 to 7-27					White
Mamie Ross	8-2 to 8-20					White
Muir	8-14 to 8-30			9-7 to 9-21		Yellow
Newhall	8-23 to 8-30					Yellow
Questin Cling			8-21			Yellow
Red Bird Cling	7-19					White
Red May				7-27 to 8-13		White
Starks Heath Cling				10-3		White
St Johns		8-9 to 8-12	8-15	8-6 to 8-17	8-27 to 8-30	Yellow
Salway	8-26 to 9-6	10-6		9-21 to 10-9		Yellow
Slappy	8-2 to 8-9	7-29 to 8-9	8-7 to 8-27	8-6 to 8-28	8-10 to 8-28	Yellow
Triumph	7-17 to 8-2	7-26 to 8-27	7-18 to 8-1	7-29 to 8-24		Yellow
Victors	7-17 to 7-23					Yellow
White Elbertas				8-22		White
Worth				8-9		Yellow
Waddell				8-21		Whtie

Compiled by C. L. Hamilton.

MARKETING

The Value of Good Packing

In the year 1911 there was an effort on the part of both the American and Canadian fruit growers to place their peaches on the English market. The difficulty in the profitable growing of peaches seemed to be with successfully marketing the product.

The peach is a fruit which cannot be picked until it is well developed and the ripening process has begun. After that period, with most varieties, it is not a long time until it begins to decay. A few varieties like the Elberta, for instance, will hold up in shipment for a considerable time, say from one to two weeks.

Consul Byington reports that the Canadian government imported into England from Canada during the season of 1911 a total of 14,000 cases of peaches shipped as an experiment to see whether Canadian peaches could be successfully placed in the English market. His report is that the shipment is a success, and that the business will be doubled next year. Consul Swalm reports as follows: "A shipment of 2,000 cases of fine peaches was received here recently from the Washington peach-growing section, and, like all Washington fruit, attracted much attention in all the markets where shown. Following a shipment from Washington came one from Ontario, Canada, the packing of which was so superior that better prices were obtained, although

the Canadian fruit was inferior in flavor and quality. Peaches are sold here in bundles of three crates each, 15 peaches to the crate, and the Canadian fruit brought $4.50 a bundle, as against $3 for the Washington product. I purchased a case of the Ontario peaches to examine the packing and found that the method employed was as follows: An open-laid crate 4 inches deep, 12 inches wide and 18 inches long is used, with a light cleat on the ends. A layer of wood wool is first put in and on this is placed the peach wrapped in a fine impervious white tissue paper and nesting in the same material. More wood wool is placed on the top of the fruit. In appearance no packing could be more attractive. The Washington fruit was packed in a less attractive brownish-white paper.

"If the American shipper will study the requirements of the market he will experience no trouble in creating a permanent demand for his fruit. Dressed in proper clothes the Washington peach could sweep the market."

Here is a case where a superior article sold for a smaller price because it was not so well dressed, showing that the beauty of the package in which an article is placed has much to do with its selling qualities.

Granville Lowther

Cost of Harvesting Peaches

Cost of box of peaches from the tree to the warehouse as worked out in the orchard of Mr. Kenneth R. Hume, Selah, Wash.:

Picking	.0365
Packing	.0265
Hauling	.0177
Warehouse	.0152
Boxes	.0475
Paper	.0165
	.1599

Varieties to Plant

As an indication of current opinion on the best varieties to plant in the various districts, the following tables are given, having been compiled from reports of nurserymen throughout the United States. The varieties are given in the order of importance based on the largest number of nurserymen reporting the variety amongst the best sellers.

The numbers at the head of the columns are those of the American Pomological Society Districts for 1909. See map on page 192.

DISTRICT NO. 8

Best Sellers

Elberta	O. M. Free
Heath Cling	Salway
Champion	Sneed
Early and Late Crawford	Susquehanna
	Stump the World
Amsden	Triumph
Bokana	Wager
Carman	Wheatland
Bernard's E.	Wonderful
Foster	World's Fair
Greensboro	Belle of Georgia
Mountain Rose	Ortiz
O. M. Cling	

New Varieties

May Flower	World's Fair
Stark E. Alberta	Ortiz

DISTRICT NO. 12

Best Sellers

Elberta

DISTRICT NO. 14

Best Sellers

Early and Late Crawford	Salway
	Triumph
Elberta	Yellow St. John

New Varieties

Gillingham	Golden
Banner	Chance
Imperial	Arkansas Beauty
Prolific	F. Elberta

DISTRICT NO. 15

Best Sellers

Early Crawford	Muir
Elberta	Fitzgerald
Charlotte	St. John
Salway	Triumph

DISTRICT NO. 2

Best Sellers

Elberta	Champion
Belle of Auburn	

New Varieties

Belle of Auburn	Engols Main
Niagara	Oceana

DISTRICT NO. 3

Best Sellers

Crawford's Late	Hiley
Char's Choice	Sneed
Greensboro	Ray
May Flower	Carman
Victor	Elberta
Belle of Georgia	Hiley
Champion	Triumph

New Varieties

Ray

DISTRICT NO. 5

Best Sellers

Elberta	Oklahoma Beauty
Carman	May Flower
Belle	Comnet's So. Ea.
Greensboro	Hiley

New Varieties

Oklahoma Beauty	Brackett
Connell's So. Early	Carson
May Flower	Kent
Munson's Free	Waller
Victor	Gold Finch

DISTRICT NO. 14

Best Sellers

Early and Late	Elberta
Crawford	Yellow St. John
Triumph	Salway

New Varieties

Gillingham	Golden
Banner	Chance
Imperial	Arkansas Beauty
Prolific	Fay Elberta

DISTRICT NO. 15

Best Sellers

Early Crawford	St. John
Elberta	Fitzgerald
Salway	Charlotte
Triumph	Muir

Best sellers as indicated by the largest number of nurserymen reporting a given variety as the best seller for his district. In order of importance:

Elberta	Crawford's Late
Belle of Auburn	Heath Cling
Triumph	Greensboro
Sneed	Belle of Georgia
May Flower	Champion
Hiley	Carman

Peaches for Washington

Peaches recommended by the horticulturist at the Experiment Station at Pullman, Wash., for the eastern part of the state. The letters (E), (M) and (L) refer to the time of ripening, whether early, midseason or late:

Peaches—(For irrigated valleys) Early Crawford (E), Elberta (M), Foster (M), Hale (E), Hill's Chili (M), Late Crawford (L), Salway (L), Wheatland (M); (for upland orchards) Alexander (E), Champion (E), Early Crawford (E), Foster (E), Hale (E), Triumph (E), Wonderful (M).

Production of Peaches and Nectarines in the United States, by Geographic Divisions and States—Censuses 1910 and 1900.

DIVISION OR STATE	Trees reported April 15, 1910				Products of 1909		Trees reported June 1, 1900 (thousands)	Products of 1899
	Of bearing age		Not of bearing age		Bushels (thousands)	Value (thousands)		Bushels (thousands)
	Farms reporting	Number (thousands)	Farms reporting	Number (thousands)				
United States	1,843,610	94,507	822,334	42,266	35,470	$28,781	99,919	15,434
Geographic Divisions:								
New England	12,860	724	7,997	572	407	632	936	105
Middle Atlantic	111,965	6,057	68,429	5,760	3,201	4,018	8,792	1,231
E. North Central	379,702	11,035	161,082	6,972	5,121	5,173	19,848	717
W. North Central	308,544	13,266	93,612	2,582	1,643	1,251	11,230	212
South Atlantic	360,895	20,583	153,940	6,138	5,572	4,888	22,029	1,412
E. South Central	343,358	10,313	158,426	3,865	5,776	4,099	10,180	550
W. South Central	274,530	22,285	134,198	8,735	3,280	2,761	17,918	2,193
Mountain	15,110	1,605	14,408	1,696	940	1,071	1,005	267
Pacific	36,646	8,639	30,242	5,946	9,531	4,887	7,981	8,745

BEARING PEACHES AND NECTARINES

The number of bearing peach and nectarine trees, reported by the 1910 U. S. Census, is as follows:

Exports of Dried Apricots—Years Ending June 30, 1906-1910

EXPORTED TO—	1906	1907	1908	1909	1910
	Dollars	Dollars	Dollars	Dollars	Dollars
Europe	1,169,473	246,906	191,162	1,338,473	1,067,696
North America	89,944	36,077	15,904	117,906	111,104
South America	6,746	11,661	6,569	5,171	8,535
Asia	17,148	13,088	4,787	10,914	12,072
Oceania	18,117	12,990	7,072	37,927	18,021
Africa	23,994	16,090	3,973	2,026	995

Exports of Dried Peaches—Years Ending June 30, 1906-1910

EXPORTED TO—	1906	1907	1908	1909	1910
	Dollars	Dollars	Dollars	Dollars	Dollars
Europe	29,386	87,449	93,371	36,750	31,348
North America	42,560	53,229	29,336	100,607	107,757
South America	8,687	11,196	7,441	4,744	6,185
Asia	4,296	3,418	529	1,583	1,574
Oceania	8,624	18,235	10,858	6,482	3,791
Africa	16,854	12,516	2,783	1,168	935

PEACHES, GRADE RULES. See *Apple Packing.*

PEACH DISEASES

Anthracnose

Gloeosporium laeticolor Berk.

Anthracnose fungus occurs rarely on peach. Careful spray treatment as for scab should be successful against this disease.

A. D. SELBY,
Wooster, Ohio.

BLACK KNOT. See *Cherry Diseases.*
BLACK SPOT. See *Scab*, this section.

Brown Rot

Sclerotenia fructigena

The brown rot is one of the most serious and widespread diseases which is known to attack the stone fruits. In most of the peach-growing districts of the East and Middle West this is the most serious disease, and in seasons of frequent summer rain may cause enormous losses. In the Northwest, on account of less frequency of summer rains, the disease seldom appears in epidemic form, but is not uncommon on the prune, peach and cherry, and occasionally on the apricot.

Symptoms

The fruit is most commonly affected. The disease appears first as small, dark-brown decayed spots, which gradually increase in size till the whole fruit is affected. The rot does not at first cause any shriveling of the tissues, nor do the spots become sunken. On the well developed spots one finds the spore-bearing structures of the fungus that causes the disease abundantly produced. These consist of cushions of threads bearing great numbers of spores in chains. They

Fig. 1. Peaches Affected with Brown-Rot Fungus. Note how the fungus has spread from the badly diseased fruit to the others in the cluster.

appear on the surface of fruits as little velvety cushions of mold not more than one-eighth or three-sixteenths of an inch in diameter. See Fig. 1. The decayed fruits frequently have a tendency to remain on the trees and slowly dry up, and may cling to the trees during the winter in a shriveled and dried up condition known commonly as "mummies." The fungus lives over the winter in such mummies, and spores, which are produced from them in the spring, start new infections.

A blossom blight may result from infection of the blossoms early in the spring. A twig blight may also be produced, but this probably only occurs when the blossoms or fruit have been infected and the fungus has gained entrance to the twig through them. The fungus is probably not able to enter the twigs directly. Peaches and apricots have been found to be more susceptible to the twig form of the disease than the other stone fruits.

As stated above, the fungus winters over in the "mummies" left hanging on the trees or lying on the ground. It is probable, also, that the disease may be carried over the winter by spores adhering to bud scales, twigs, etc.

Cause

The brown rot on plums, peaches and apricots is caused by a fungus known as *Sclerotinia fructigena*. This fungus exists in two spore forms. The summer spore form has already been described. The winter or sexual spore stage develops in the early spring from mummies that have fallen to the ground. This stage does not ordinarily develop on the mummies until after they have lain on the ground for 18 months.

This stage of the fungus is developed from resting masses of mycelium called sclerotia, which develop in the tissues of mummified fruits. A definite fruit body is produced known as an apothecium and commonly spoken of as a "cup fungus." This consists of a slender stalk bearing at the summit a cup-shaped structure, one-quarter to one-half inch in diameter. These are found at the surface of the ground, surrounding buried or half-buried mummies. Several may be formed from the same mummy. The inner surface of the expanded bell-shaped portion is lined by great numbers of cylindrical sacks called asci, each of which contains eight spores. These asci form a smooth layer. The details of structure are visible only on miscroscopic examination. The spores are ejected forcibly from the asci, and, wafted by currents of air, reach the trees. It is probable that much of the blossom blight is caused by direct infection from these spores.

Control

From what has been said, it is evident that the destruction of all mummified fruit in fall and winter would aid in controlling the disease. It is a bad practice to allow diseased fruits to remain in the orchard, since, as shown above, the fungus is capable of living over winter in such mummies and starting the disease in the spring. Plowing in the spring before the buds open is to be recommended where possible, and when consistent with good horticultural practice. This method would probably not entirely prevent the formation of the winter spore stage and therefore, where practical, the decayed fruit should be gathered and destroyed in the fall.

Peaches should be thinned so that no two fruits touch each other, as it is found that moisture may be retained at the point where the fruits touch and thus favor infection.

Where the disease is serious the trees should be protected by a fungicide. Since this disease is not serious in all sections of the Northwest, spraying, as a general orchard practice, may not be necessary for all growers. Previous experience must be taken into consideration in deciding whether sufficient loss is likely to occur to warrant spraying.

It has been found in most peach-growing sections to be unsafe to use Bordeaux mixture or commercial lime-sulphur on peach foliage except in very weak strength, so that a special spray known as self-boiled lime-sulphur is recommended for use on peach foliage.

The following method of preventing brown rot on the peach in the East and Middle West has been recommended by Scott: 1. Three or four weeks after the petals fall spray with 8-8-50 self-boiled lime-sulphur. 2. Three weeks later repeat, using the same mixture. 3. Spray again about one month before the fruit is expected to ripen with the same mixture.

On the prune, Bordeaux mixture, 4-4-50, or commercial lime-sulphur, 1-30, would doubtless be safe to use. The applications should be made as recommended for peach.

Scott has shown that the self-boiled lime-sulphur, 10-10-50, the commercial lime-sulphur, 1-40, and Bordeaux mixture, 2-4-50, may be used safely on the cherry in the East. The writer would suggest that cherry growers who find it advisable to spray for this disease try any one of these mixtures.

H. S. Jackson,
Corvallis, Oregon.

California Peach Blight and Fruit Spot
Coryneum beijerinckii

One of the very important diseases of the peach in Oregon is the so-called California peach blight or fruit spot. The disease has also been referred to as the winter blight. The disease has been quite pervalent for some years in the peach-growing sections of the Rogue River valley, particularly in the vicinity of Ashland. It has also been reported from various sections of the Umpqua and Willamette valleys and has recently been reported as serious in the Milton-Freewater district of Umatilla county. It seems to be rapidly spreading in the state, but since no thorough survey work has yet been attempted with special reference to this disease, the exact distribution is unknown. It has also been for many years one of the most serious diseases of the peach in the peach-growing sections of California, where the greater part of the investigations concerning its cause and control have been conducted.

Symptoms

The most evident symptoms are the dying of the buds on the fruiting wood,

Fig. 1. Cankers of Peach Blight on First Year Growth.

accompanied later by a splitting of the bark on the branches of the current year's growth. The buds may die before spring and fail to develop altogether, or they may start and later die after the leaves are well out and the young fruit set. Under the latter conditions the foliage and young fruit die and later fall. Usually associated with the dying of the buds and spots on the twigs is a copious "gumming," which manifests itself in the exudation of masses of gelatinous sap from these spots and from the dead buds. The exudation of gum is most abundant in wet weather, and

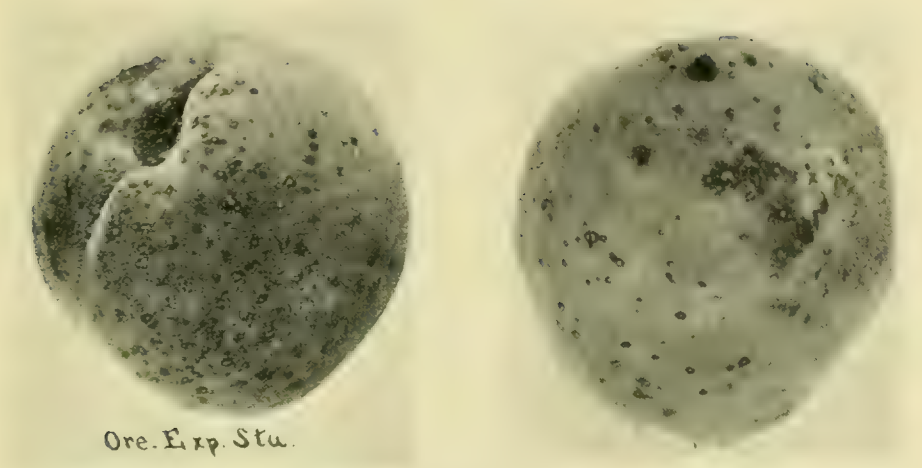

Fig. 2. Fruit Affected with the Fruit-Spot Stage of California Peach Blight.

where the disease is abundant, forms one of the most characteristic symptoms.

The spots frequently develop into small cankers which may girdle the twigs. These may start on twigs of the current year's growth, as shown in Fig. 1. Similar cankers are found associated with the buds that have been killed. The twigs and branches killed in this way are usually found first in the lower part of the tree. The disease progresses upward and in serious cases only the top branches of the tree may be healthy. This mode of progress of the disease may be related to the fact that moisture is held longer in the lower branches of the tree and hence the conditions for the development of the disease are more favorable than in the upper branches.

On account of the fact that the one-year wood in the peach develops the fruit buds, it is seen that the form of the disease above described is capable of causing almost if not complete failure of the crop.

Constantly associated with the phase of the disease on the twigs, is a characteristic fruit spot and shot-hole effect on the leaves. On the fruit, the spots resemble the effect produced by the San Jose scale. These are shown in Fig. 2, The spots are at first rather small and purplish red. As the disease progresses the spots become larger and a light-colored area develops in the center. Later the spots turn brown and where abundant become confluent. On badly affected peaches cracks may appear and a more or less copious exudation of gum may make its appearance. While inoculation experiments have not yet been carried out to prove that the spots on the fruit and leaves are caused by the same fungus as that which causes the twig blight, it is highly probable that such is the case.

Cause

Peach blight is caused by a parasitic fungus known technically as *Coryneum beijerinckii.* This fungus is known only in the summer spore stage. A sexual stage, if it exists, has not been certainly associated with this disease. The fungus, which is the initial cause of the dying of the buds, and of the formation of the spots and cankers on the twigs, produces little three or four-celled brown spores on the ends of threads from little cushions which break through the outer bark. These cushions are visible to the unaided eye as black spots or pustules. What is evidently the same fungus has been found associated with the fruit spot and shot-hole of the leaves.

Remedy

In California it has been found that the disease may be kept under control by regular fall spraying with Bordeaux mixture without spring applications. In Oregon the fall application is undoubtedly the most important, but where the disease is firmly established it is probable that spring applications will also be necessary. After the disease is under control, and where fall spraying is regularly practiced, it may later be found that the spring spraying may be dispensed with.

H. S. JACKSON,
Corvallis, Ore.

Cankers

The term "canker" is to be applied to any definite dead area in the bark of the limbs or body of the tree. There are several cankers of the peach tree. The one most frequently spoken of is perhaps the Valsa canker. This is a very common canker on the bodies of the trees just above the ground or on the larger limbs. Sometimes the twigs of the trees appear to be killed by the same disease. The losses from this malady are sometimes serious.

Symptoms

The cankers appear as dead, sunken areas in the bark, at first at least, with no definite cracking of the bark along the margins of the diseased area. The bark in to the wood appears to be killed and the depression results chiefly from the formation of a new wood layer over all the parts of the trunk or limb except where the bark has been killed. The yellowing of the foliage and the dying of the tree follows as the diseased areas enlarge and girdle limbs or body. The surface of the cankers soon show the white tips of the fruit bodies protruding through the checks and cracks of the dead bark.

Cause

Whether the fungus *Valsa leucostoma* so commonly present in the dead bark of these cankers is the primary cause of the injury is rather doubtful. It appears more probable that these cankers or dead areas are the result of winter injury, and the fungus always present on dead limbs and twigs in the peach orchard quickly finds its way to this injured bark and there develops rapidly, no doubt extending the original injured area from year to year. Here it produces its spores in the fruit bodies sunken in the bark, the white tips of which protruding permit the extrusion and dissemination of the spores. It is generally observed that this disease is much more severe the season following severe winter injury.

Control

The prompt cutting out of the diseased bark as soon as the cankers are discovered is the only measure to be suggested. Cut half an inch or so out into the healthy bark all round the diseased area. Carefully and thoroughly clean away all the diseased tissue and tar the wound with gas tar or paint with good paint free of turpentine.

H. H. WHETZEL,
N. Y. State College.

A New Disease of Peaches

The disease occurs in the Niagara district and extends into New York state wherever peaches are grown. It manifests itself by larger or smaller cankers occurring on trees of all ages, often somewhat like the common black knot of plums and cherries. Closer examination shows, however, that these "knots" are characteristic canker spots. They may occur on all parts of the tree, the main trunk, especially the crotch, smaller limbs and quite young wood. In some instances, the cankers encircle the whole limb, rendering it liable to be broken by wind or by the weight of the fruit that may still be produced. As far as could be learned from a personal examination of a number of orchards, the disease is contagious and spreads rapidly. No variety seems exempt from an attack and the age of the tree seems to make little difference. The disease was first observed by growers about four

years ago, but no steps were taken to investigate it. It has now become very serious and is under investigation.

H. T. Gussow,
Ottawa, Canada.

Crown Gall. See *Apple Diseases*.

Frosty Mildew. See *Leaf Spot*, this section.

Gum Flow. See *Blight*, this section.

Gummosis. See *Blight*, this section.

June Drop

June Drop is often named by peach growers as a specific trouble. It consists in the dropping of the young peaches during the month of June, though dropping sometimes comes earlier. The cause seems to be physiological and need not be feared where the trees have been prevented from overbearing, or protected from the effects of drought by thorough cultivation the previous season. See Setting and Dropping of Fruits, under *Fruits*.

Little Peach. See *Yellows*, this section.

Leaf Curl

Exoascus deformans

H. S. Jackson

The most common and destructive disease of the peach in the humid sections of the Northwest, and probably wherever the peach is grown in that region, is without doubt the peach leaf curl or "curl leaf," as it is most commonly known among growers.

Symptoms

The disease may be recognized by the characteristic effect upon the foliage and twigs. The leaves are peculiarly and characteristically curled as shown in Fig. 1. This curling results from a stimulation induced by a parasitic fungus, which grows among the cells of the leaf. The infected leaves become considerably increased in thickness and breadth. The cells of the tissues develop thickened walls and increase in size and number. The tissues of the midrib do not increase to any extent and the abnormal growth in the tissues on either side, as described above, results in a puckering or curling. Since the greatest growth is in the tissues toward the upper side, there is a tendency for the upper surface of the curled leaf to be convex. Affected twigs are increased in thickness and very much shortened. The green coloring matter normally present in healthy twigs is bleached out so that diseased twigs appear whitish.

Cause

The parasitic fungus causing the trouble is known as *Exoascus deformans*. The vegetative condition of the fungus (the mycelium) is present among the cells of all diseased tissues and absorbs the juices needed for the proper growth of the tree, thus stimulating the tissues to produce the abnormal structures described above that are not able to properly perform the functions of normal tissues. Reproductive bodies or spores are produced in little sacs which form a layer on the surface of affected leaves. These form under the cuticle, finally pushing it off and imparting to the surface a frosted appearance. In each sac are borne at first eight spores. These become greatly increased in number by budding within the sac. The spores thus formed escape by the rupture of the sac. These spores, which are presumably carried over the winter on the surface of twigs and bud scales, produce infection as soon as the leaf buds open in spring.

Affected foliage usually drops, and, where abundant, may cause more or less complete defoliation of the tree. Such trees set little or no fruit. Defoliated trees usually leaf out again, so that in midsummer little sign of the disease may be found. The effect of such defoliation, however, is to stunt the tree. Trees allowed to become infected year after year are usually unprofitable.

Besides the method mentioned above, the fungus may be carried over from one season to the next by the mycelium living over the winter in the twigs. The fungus probably gains entrance to the twigs by the growth of the mycelium down the leaf stalks of affected leaves into the twig. Where such twigs remain alive over the winter the leaves produced in the buds on these twigs will always

be infected. Fortunately, only a few branches become infested in this way and the majority of these die before the next spring, leaving only a very small percentage of the infection caused by this method even in serious cases.

Control

Since the great majority of infections take place at the time the buds open in the spring, from spores adhering over winter to the bud scales and twigs, it is obvious that a spray that will kill the spores or prevent their germination, ap-

Fig. 1. Peach Leaves Affected with the Fungus Causing Peach Leaf Curl. Note the wrinkled and distorted tissues.

plied early in the spring before the buds open, will control the disease.

Use the Bordeaux mixture, 5-5-50, or the lime-sulphur 30-degree Beaume, diluted 1-15, and apply early in the spring just before or while the buds are swelling, but before any of the buds show any green. If any of the buds show even the green tips of the leaves, they may become infected.

Spraying will not prevent infection resulting from the mycelium wintering over in the bark of twigs. Fortunately this method of wintering over accounts for only a small proportion of the infection.

In spraying for leaf curl it is important that every twig be thoroughly covered with the spray.

The general experience of investigators has shown that either of the sprays mentioned are equally good in preventing this disease. Experiments carried out by the Department of Plant Pathology in the spring of 1910 confirm the results of these investigators. From observations made during the spring of 1912 it would seem that the growers had more uniform success when the Bordeaux mixture was used.

Peach Shot Hole

Cercospora circumscissa Sacc.

The effects of this disease resemble those caused by *Cylindrosporium* of the plum. The diseased spots fall out, and the small branches are also attacked, often causing a great number of the young shoot to diet. Spray with lime-sulphur, as for peach leaf curl.

R. D. Whitmarsh,
Amherst, Mass.

Powdery Mildew

Sphaerotheca pannosa
Podosphaera oxyacanthae

H. S. Jackson

Powdery mildew is not an uncommon trouble on peaches, though sel-

Fig. 1. Powdery Mildew on Fruit of Peach.

dom serious. Trees are occasionally so seriously affected, however, that they are unprofitable. Mildew may occur upon the twigs, leaves and fruit. It may appear on the fruit while quite small or during any stage of growth and is characterized by the presence of white frosty spots of mold. At certain stages of growth it has a powdery surface. Sometimes the entire fruit is affected, though commonly only a portion of the surface is attacked. Fig. 1 shows the characteristic appearance of the disease on the fruit. Where it is abundant upon the fruit, the latter is ruined for the market. On the twigs the moldy growth may occur as white blotches. The leaves which are also usually attacked, are covered with a white growth and are usually more or less stunted and

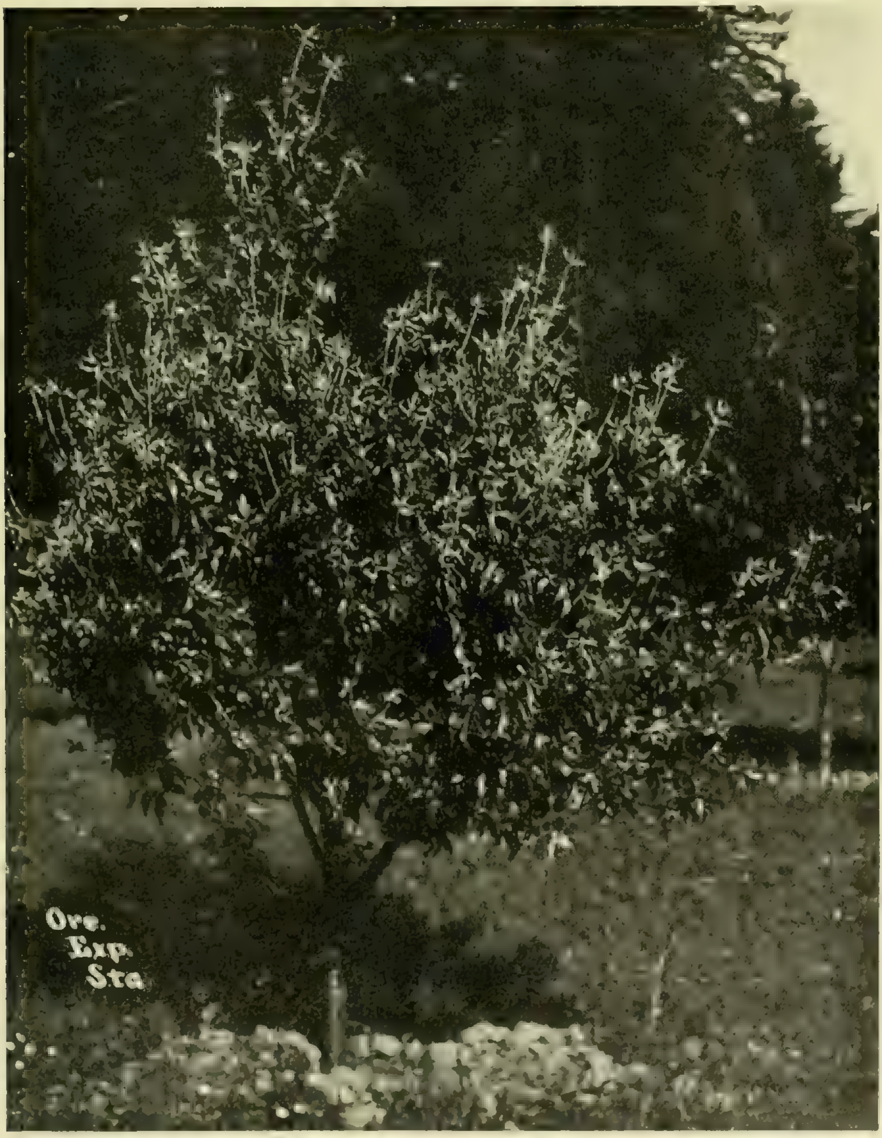

Fig. 2. Peach Tree Badly Affected with Powdery Mildew in the Generalized Form.

curled, and in severe cases fall prematurely. While usually the entire leaf is affected, the mildew occurs also in spots and then appears most abundantly upon the under surface.

Powdery mildew on the peach seems to occur in two general conditions. The disease may be scattered on the fruit and leaves, with a few twigs affected; this may be referred to as the scattered form, and is the most common condition of the disease. Occasionally, however, trees are found on which the disease is generally distributed, when practically all the twigs are attacked and the general growth of the tree is seriously interfered with. This may be referred to as the generalized form. See Fig. 2.

In general the disease may be said to be more abundant upon seedlings, though the standard commercial varieties are not uncommonly attacked.

Cause

Two mildews are reported upon the peach, namely, *Sphaerotheca pannosa* and *Podosphaera oxycanthae*. It is possible both of these diseases occur in the Northwest and that the scattered form is due to the former species, while the more generalized form is due to the latter. The species of powdery mildews are determined from the characteristics of the perfect stage which develop late in the season as small black bodies in the moldy blotches on the twigs. This perfect stage is seldom produced on the peach, and no studies have been made to determine the exact species occurring in the Northwest.

Remedy

Where occurring in the scattered form on a few twigs and the fruit, the disease can doubtless be held under control by the methods described for the spring treatment of California peach blight or for the brown rot. Where the disease attacks a tree in the generalized form, it is very difficult to control, and ordinary spraying methods, according to our observations, have not been successful. In many cases such trees are found to be seedlings and should be taken out. If this condition occurs upon standard varieties, severe cutting back followed by thorough spraying should be tried as a remedy. It is suggested that the grower combine the recommendations given for California peach blight in the fall and for peach leaf curl and brown rot in the spring.

* See Circular Bulletin 13, Oregon Experiment Station, for the details of preparation of this mixture.

Crown Gall. See under *Apple*.

Mushroom Root Rot. See under Apple.

Pustular Spot

Helminthosporium carpophilum Lev.

Pustular spot of the peach is a disease referable to a minute fungus, which is apparently spread by spores that alight upon the upper surface of the fruit, flourish there and produce minute, light-brown spots, often surrounded by an angry red border. The red border is conspicuous in earlier varieties and is sometimes elevated and pustular in appearance. This fungus greatly disfigures the fruit and is very easily prevented. Three applications of Bordeaux mixture have reduced the amount of pustular spot to less than one per cent; whereas unsprayed trees gave more than 16 per cent of spotted fruit, much of which was seriously damaged.

A. D. Selby

Root Rot. See *Apple Diseases*.

Rot. See *Brown Rot*, this section.

Rosette. See "*Yellows*," this section.

Rust

Puccinia pruni-spinosae

H. S. Jackson

A true rust of the foliage of prunes is not uncommon, though it is seldom present in sufficient amount to be considered serious. This disease is caused by a fungus known technically as *Puccinia pruni-spinosae*. It is most abundant late in the season and when serious may cause a premature falling of the foliage. The disease is also known to attack the peach, plum and other related trees. The disease may be recognized by the appearance of small dusty brown or black sori on the under surface of the leaves. On the upper surface yellowish spots appear. It is

probable that under Northwestern conditions, should the disease become serious enough to warrant special remedy, Bordeaux mixture applied in the middle of August or first of September would control the disease.

Scab or Black Spot

Cladosporium carpophilum Thum.

This fungus is a serious drawback in the growth of certain varieties which seem susceptible. These are Morris, White, Salway and some other late sorts. It causes dark spots upon the fruit followed by cracking and entrance of the rot fungus with serious results. To control this disease, spraying with self-boiled lime-sulphur is the remedy to be applied at intervals of two to three weeks after foliage appears.

A. D. SELBY

Sooty Mold of the Peach

When the fungus is present, the bark of the trunk and inner limbs become covered with a sooty mold, giving the bark a black appearance; it later in the season covers the foliage and fruit, interfering with the health of the tree and the development of the fruit, rendering it unsightly.

Where winter spraying is done, very little if any is found; orchards affected with it should be sprayed while trees are dormant, with lime and sulphur solution, or Bordeaux mixture.

J. H. FUNK,
Boyertown, Pa.

Stem Blight

It is due to a specific fungus which attacks the stems of nursery stock, causing a constriction, and this is in line with the effects of the fungus described from Europe as a constriction or lacing disease. Infection may be prevented by treatment with fungicides.

A. D. SELBY

Winter Injury

In cold climates severe freezing of winter often injures the trunk and branches of peach trees. The killing back of new growth is a common occurrence. Also the killing of the trunk on one side, usually the west or southwest. The indications are that where there has been late growth of the trees followed by severe winter cold, such injury may be expected. Late cultivation or irrigation should therefore be avoided.

Yellows

Peach yellows is a serious, contagious disease of this fruit. Only in certain seasons may we find yellowish color as a marked symptom of affected trees. The true symptoms of yellows are: 1. Premature ripening of the fruit, which is highly colored, often purplish spotted, and has the flesh marbled with red. 2. The premature growth of winter buds, resulting in excessive branching on new shoots, and the development of slender, wiry branched twigs. 3. Resting buds or adventitious buds are formed on the trunk and branches; these grow into sickly shoots with pale, narrowed leaves, and usually become much branched, with tips like veritable brooms. Aside from these specific evidences of yellows, which serve to distinguish yellow color from true yellows disease, there are others less easily described but none the less useful to the practical observer. This disease may be recognized late in the season by the late, adventitious growth. The sources of disease are diseased trees or affected nursery stock, more often the former. The remedy is to remove and to burn the yellows trees, root and branch, on the spot where found. Dragging diseased branches may spread yellows and all such trees are a menace. To leave an open hole over winter and replant the next year is a safe practice.

Recent investigations of this disease show that it is due to an enzyme which converts the leaf chloryphyll into a diseased form, causing yellows conditions. It is doubtless this enzyme which is transmitted, as in the case of tobacco, by actual contact. These discoveries have changed in no way our method of handling the disease.

Rosette of peach is a disease of the Southern states which appears to be similar in cause and transmission to peach yellows.

A. D. SELBY

Little Leaf California Yellows

Characterized by the development of spindling, yellow, sickly looking shoots on the new growth, with small, narrow, yellow leaves. The leaves along the shoots drop off during the summer, leaving tufts at the ends. Fruit fails to develop, shrivels and drops. Worst on trees from three to seven years old.

This trouble also attacks other stone fruits, walnuts, pecans and other trees. Always worst on lighter, drier soils, this feature showing itself by the more pronounced occurrence of the disease on trees standing in sandy streaks or slight elevations in the orchard.

This trouble has no relation to the true Eastern peach yellows, but is decidedly climatic and seasonal in its appearance. Occurs mostly following unusually dry seasons, on trees standing in light soil or one underlaid with a coarse, sandy subsoil. Trees on a fairly heavy subsoil, or those which have received abundant irrigation throughout the preceding season, are decidedly free from the trouble even in the worst affected localities. Appears similar in nature to "mottled leaf" of the orange, and, in fact, orange trees growing near peaches affected by "little leaf" show a typical "mottled leaf" condition. Many other kinds of trees are also more or less affected.

In most cases, regular irrigation during the summer shows a marked effect in controlling this trouble. Such irrigation should be given particularly in the latter part of the season, after the crop is off, especially when the rains are late in commencing.

Climatic Effect

The trees fail to leaf out properly in the spring and seem to become confused, so to speak, as to the season. Later in the summer the trees may bloom and leaves begin to appear, but the tops usually die back nearly to the forks of the tree and sometimes the trees die entirely. If not too badly affected, the tree sends out new sucker growth from the trunk and base of the main limbs. Plums, apricots, apples and other trees are sometimes affected.

This trouble is one which occurs mostly in the southern part of the state as a result of unseasonable climatic conditions. It is usually most pronounced in seasons when a period of warm, stimulating rains in the winter is followed by a long, cold spring. Similar results are also produced by an abnormal, dry fall, throwing the trees into a dormant condition, followed by warm, spring-like weather accompanying the winter rains. These combinations and various others often have unfavorable effects upon trees which are accustomed to a definite resting period during the winter. Many peculiar diseases of deciduous fruits described in this bulletin under various names, such as "die back," "yellows" etc., are no doubt contributed to by such disturbances in the normal period of dormancy. Every few years there is usually a season, especially in the southern part of the state, when deciduous trees are badly affected in such ways as these.

Following such an attack trees should be pruned back to healthy, vigorous wood, when they will usually form a new top and come back into good condition again. With peaches it is noticeable that varieties of the saucer or Peen To type are not affected in this manner, as are the Persian varieties.

R. E. Smith,
California Experiment Station Bulletin 218.

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PEACH PESTS

Apple Tent Caterpillar. See *Apple Pests*.

Black Peach Aphids. See *Aphids*.

Brown Mite

Bryobia pratensis Garman

The young mites hatched from eggs early in spring are bright red and have

only six legs. Later they become olive green or brown and have eight legs. They feed principally upon the leaves, occasionally attacking the fruit, and may be detected by the faded-out appearance of the foliage.

Control

Spray with lime and sulphur. This not only kills the adults, but also destroys the young mites as they hatch. Sprays such as emulsions, resin wash and soap solutions are efficient remedies, but these are usually too destructive to the tender leaves of the plant to be practicable. The flour paste spray made of four pounds of flour in one hundred gallons of water and one gallon of lime-sulphur solution is especially recommended for mites.

BUFFALO TREE HOPPER. See *Apple Pests.*

CALIFORNIA PEACH BORER. See *Western Peach and Prune Borer.*

CANKER WORM. See *Apple Pests.*

CITRUS RED SPIDER. See *Apple Pests.*

CITRUS THRIPS. See *Pear Pests* for control of thrips.

CLIMBING CUTWORM. See *Apple Pests.*

COMMON TERMITE. See *Apricot Pests.*

COTTONY MAPLE SCALE. See *Apple Pests.*

EASTERN TENT CATERPILLAR. See *Apple Pests.*

EUROPEAN FRUIT SCALE. See *Apple Pests.*

EYE-SPOTTED BUD MOTH. See *Apple Pests.*

FALL WEB WORM. See *Apple Pests.*

FLAT-HEADED BORER. See *Apple Pests.*

FOREST TENT CATERPILLAR. See *Apple Pests.*

FROSTED SCALE. See *Prune Pests.*

FRUIT BARK BEETLE. See *Apple Pests.*

FRUIT TREE PULVINARIA. See *Prune Pests.*

Green Stink Bug of the Peach

Nezara hilaris

The green stink bug of the peach sometimes does great injury to the fruit of the peach. It is also a great nuisance in the orange groves of Florida, causing the fruit to fall because of its punctures. The damage commences in early summer when the young nymphs thrust their sucking, needle-like beaks into the young fruit to imbibe the sap. Damage is continued until late in the fall. The fruits become rough and knotty, somewhat shriveled, flecked over with drops of exuding gum, and the pulp is hardened along the line of puncture. The injured fruit is quite persistent to the tree and does not drop. The development of the insect in excessive numbers seems to depend upon some climatic factor, possibly a succession of dry seasons. With average conditions it attracts comparatively little attention. Not enough is known of its life-history and habits to warrant specific recommendations. There are some grounds for believing that dense cover crops in the orchard encourage its multiplication.

H. A. GOSSARD

Ohio Agricultural Experiment Station Bulletin 233.

GREEN APPLE WORM. See *Apple Pests.*

Hemispherical Scale

Saissetia hemisphaerica Targ.

General Appearance

This species is not quite as large as the black scale. Regular and oval in shape with polished surface and rich brown color without markings.

Life History

The eggs are very minute and vary from pearly-white to cream color. The life history is practically the same as that of *Saissetia oleae.* On citrus trees the scales are often found around the margins of the leaves, but on other plants the stems and foliage are attacked. Not a serious pest.

Food Plants

The pest has a wide range of food plants. Works upon the foliage and stems, but is occasionally found upon citrus fruits.

Control

On deciduous fruits and olive trees the following sprays may be used when the scales are no more than half grown: Water distillate, distillate, caustic soda, mechanical mixture and distillate emulsion.

Hemispherical Scale.

Natural Enemies

The black ladybird beetle, the egg parasite and certain internal parasites aid greatly in keeping down the numbers of this insect.

E. O. ESSIG

Lesser Peach Borer
Synanthedon pictipes F. & R.

This borer resembles somewhat the Western peach and prune borer, but is smaller. It is known in some sections as the "wild cherry borer." It attacks a variety of plants of the plum and apple family.

It differs from the peach borer in the fact that it apparently attacks only injured trees and its burrows are more irregular and larger.

The lesser peach borer is native to this country and is found pretty generally distributed over the United States.

For method of control, see *Western Peach and Prune Borer*, this section.

Bureau of Entomology Bulletin 68

OBLIQUE-BANDED LEAF ROLLER. See *Apple Pests.*

Peach Bud Mite

For the past 15 or 20 years nurserymen in the East have complained of a well-defined trouble of peach nursery stock, resulting from injury to the tender terminal bud of the principal shoot. The injury causes the cessation of further upward growth of the shoot and results in the development from the lateral buds of numerous branches, a condition very objectionable in stock of this class where a single vigorous shoot is desired.

Habits and Natural History

According to Prof. Waite the mites hibernate on the plants behind the bud scale. The mites appear on the trees quite early in the spring and by the time the shoots are 18 or 20 inches in height their injury is much in evidence.

Control

A thorough application of a suitable spray to the infested trees, especially during the period of attack in late spring, should be of value. At this time the mites are on the trees in numbers, and by thorough spraying many of them should be killed. A contact spray such as kerosene emulsion or whale-oil soap solution should be effective, and especially the self-boiled lime-sulphur wash. Most observers agree that the mite is more prevalent on trees on low situations.

Bureau of Entomology Bulletin 97.

PEACH GREEN APHIS. See *Aphids.*

PEACH GREEN LOUSE. See *Aphids.*

PEACH LEAF CRUMPLER. See *Apple Pests.*

Peach Lecanium, Bark Louse, Terrapin Scale, Lecanium
Eulecanium nigrofasciatum Pergande

This scale insect can be recognized and identified especially well in the hibernating winter stage (Fig. 1), when it appears as a reddish hemispherical scale 2 mm. in length, mottled with radiating streaks of black which are especially conspicuous about the margin. Sometimes these radiating streaks coalesce, forming a subdorsal dark band surrounding the

Fig. 1. Terrapin Scale (*Eulecanium nigrofasciatum*). Adult females on twig of peach. (Purdue Experiment Station)

central reddish boss. Occasionally individuals are found which are entirely red or black.

Food Plants

For many years the terrapin scale has been considered a specific enemy of the peach and has been confounded by many entomologists and others with *Eulecanium persicae* (Fab.), the pre-eminent peach soft scale of Europe. At present we know it as infesting a large number of host plants, including many varieties of peach and cultivated plums; various species of wild plums and cherries, apple, pear, quince, several species of Crataegus, three species of maple, oriental and western sycamores, Carolina poplar, olive, blueberry (*Vaccinium* sp.).

Distribution

This scale has been reported from very nearly the entire section east of the Rocky mountains.

Parasites

Very small, parasitic four-winged flies of the genus Coccophagus, family Chalcididae, are our greatest benefactors in the control of this scale insect.

Remedies

Unfortunately the lime-sulphur wash, which is such an excellent remedy for the San Jose scale and which at the same time controls the peach leaf-curl, is worthless for treating the terrapin scale. Numerous experiments in the use of the lime-sulphur wash against this scale on various host plants have produced only negative results.

Kerosene emulsion has proved to be the most effective remedy for the control of this pest. This emulsion, when properly made according to the formula below, can be sprayed with safety on any tree during the dormant period—in winter or early spring before the buds open —at a strength of 20 to 25 per cent. A nozzle throwing a fine spray should be used. Care should always be exercised to prevent the liquid from running down the trunk of the tree and collecting about the roots, as the oil, which will be retained by the soil around the roots for an indefinite period, might seriously injure or kill the tree.

KEROSENE EMULSION

Stock solution (66 per cent oil)

Kerosene (coal oil, lamp oil)	2 gal.
Whale oil or laundry soap (or 1 quart soft soap)	½ lb.
Water	1 gal.

Dissolve the soap in boiling water, then remove from the fire, add the kerosene immediately and thoroughly agitate the mixture until a creamy solution is obtained. This can be done by pouring the mixture into the tank of a spray pump and pumping the liquid through the nozzle back into the tank. This is a stock solution which must be diluted before using. In order to make a 20 per cent emulsion, add to each gallon of the stock solution and 2 1-3 gallons of water and agitate thoroughly before using. For a 25 per cent solution add to each gallon of the stock solution 1 2-3 gallons of

water and agitate thoroughly. This strength will kill a large percentage of the hibernating females, without injury to the trees.

If a good naphtha soap can be obtained the preparation of the emulsion will be simplified. It will be unnecessary to heat the solution, since the kerosene will combine readily with the naphtha and soap and form a perfect, cold, milky-white emulsion when the mixture is thoroughly agitated. If naphtha soap is used, double the amount called for by the formula, and emulsify in soft (rain) water.

Bureau of Entomology Circular 88.

Peach and Plum Slug

Peach Saw Fly

Caliroa (Eriocampoides) amygdalina Rohwer

The adult saw flies are very active little insects, running back and forth across the leaf on the upper side and occasionally stopping to sip the nectar at the nectaries at the base of the leaf. This seems to be its chief food. The adults appear first in early spring and may be found until cold weather in the fall. There are about seven generations each year, the last one hibernating over winter.

The larva is of a peculiar slug-like appearance, swollen in front and covered with the slimy secretion which hides the segmentation of its body. The head is pale brown and the eye spots darker. Its body is translucent and the course of the alimentary canal can be traced by the green food within. The slug feeds upon the green leaves of the trees to such a degree that trees are sometimes completely defoliated in August.

Remedies

Without doubt an arsenical spray, such as arsenate of lead, would very effectively destroy these insects, and this poison is advised when the insects occur in sufficient numbers to warrant treatment. The rapid increase in the spraying of peaches and plums with arsenate of lead in self-boiled lime-sulphur wash for the control of the plum curculio and fungus diseases of the fruit will unquestionably result in keeping the peach and plum slug well reduced in orchards. Its occurrence in injurious numbers is to be looked for largely in small unsprayed home orchards.

Peach Tree Bark Beetle

Phlaeotribus liminaris Harr

The peach tree bark beetle is native of this country and until cultivated trees were introduced must have held to forest trees for food and breeding places. The work of the beetle is similar to that of the fruit tree bark beetle (*Scolytus rugulosus*, Ratz), and there exists a marked similarity in the beetles themselves by which the two species may be easily confused.

Distribution

From Ohio eastward.

Extent and Character of Injury

When the beetles are present in large numbers their injury to the trees is quickly brought to the attention of the orchardist by the large amount of sap exuding from the trees through the many small borings made both in the trunk and limbs of the tree. In some instances from one to three or more gallons of sap will flow from a single tree during a season.

The adults or beetles produce the primary injury to healthy trees, the work of the larvae being secondary. The healthy trees, by repeated attacks of the adults, are reduced to a condition favorable to the formation of egg burrows. When the beetles are ready to hibernate in the fall they fly to the healthy trees and form their hibernation cells. These latter are injurious to the trees, for through each cell there will be a tiny flow of sap during the following season.

Methods of Control

Pending further investigation the following treatments are suggested as being practicable and to a certain degree favorable: For trees seriously injured—Severely trim back the trees and apply barnyard manure or commercial fertilizers; then apply a thick coat of white-

wash three times a season, the first application to be made the last week in March, the second application during the second week in July, and the third application about the first of October. For trees apparently healthy but slightly attacked—Paint the trees with a thick coat of whitewash three times each season as in the previous treatment, applying it to the trunks and larger limbs. The whitewash applied at the time specified will act as a repellent, the emergence of the beetles being slightly later than the dates given for the different applications. Add one-fourth pound table salt to each pail of whitewash, thus making the latter more adhesive. All of the dead, or nearly dead, limbs and trees should be removed and burned as fast as they appear in an orchard, as this will destroy the breeding places.

H. A. GOSSARD

Ohio Agricultural Experiment Station Bulletin 233.

The Peach Twig Borer

Anarsia lineatella Zell

One of the most common enemies of the peach in the United States is the twig borer, or "bud worm" as it is sometimes called. Its occurrence has been reported from most of the peach-growing states of the Union, both in the East and West.

The adult of the twig borer is a tiny, dark-gray moth. It is an Old World species, supposed to have come to us with the peach from Western Asia, and has been known in the United States since 1860.

Kind of Trees Affected.—The twig borer is principally an enemy of the peach, and usually we hear of it in connection with its damage to this fruit. It may be found, however, on all stone-fruit trees, but shows a decided preference for the peach. In Bulletin 80 of the Bureau of Entomology of the United States Department of Agriculture, Dr. Marlatt mentions the pear among its list of food plants. The writer has never noted the attack of this insect upon other than stone-fruit trees. Its occurrence on the pear or other pome fruits is probably rare, and might be compared to the occurrence of the codling moth, which is almost exclusively an enemy of the pome fruits, in plums, peaches, or other stone fruits. While cases of codling moth infesting stone fruits in any numbers are rare, they were found the past season in Colorado so plentiful in Burbank plums of a certain orchard that they were really doing considerable damage. The twig borer, during a season of abundance, might occasionally modify its habits to the extent of an occasional attack upon pome fruits, as the codling moth in a season of abundance may modify its habits and occasionally attack stone fruits.

The Larvae and Their Injury.—The larvae hibernate in little silk-lined chambers constructed within the bark and very close to its surface.

While hibernating they vary somewhat in size but are all very small, and their detection is somewhat difficult except when very close observations are made. The presence of the larvae during the hibernating period could scarcely be detected were it not for the fact that they construct, at the entrance to their burrows, tiny silken tubes covered on the outside with bits of bark which were chewed off while excavating the hibernaculare. These little tubes are shown in

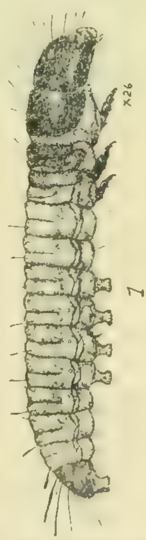

Fig. 1. Larva of Twig Borer Magnified Twenty-six Times.

the crotch of a tree in Fig. 3 and again one is shown at the entrance to a burrow containing larva in Fig. 2. The larval cell is also lined with silk. The silken tube being merely a continuation of this cell lining. Throughout the winter months the hibernating larva remains in-

Fig. 2. Hibernating Chamber of Twig Borer.

active within this cell. A hibernating larva magnified 26 diameters is shown in Fig. 1. These larvae are exceedingly well protected in their hibernaculae, and Mr. Warren T. Clarke's experiments in California show that they are almost impenetrable to even an oil spray during the winter season.

In the spring of the year, about the time the peach trees bloom, the larvae leave their winter quarters and eat into the tips of the twigs, either beginning their work at the extremities or a short distance below, sometimes hollowing them out for usually a distance of less than an inch from where the twig was entered, leaving a mere shell or hollow cylinder of the portion in which they have fed. Again, they may merely gouge out the tip of a twig on one side, entering in as far as the pith and then leaving for some other twig. Thus they go from twig to twig, feeding first in one and then in another, until often the tips of a great many branches will be killed back, thereby checking their growth and more or less injuring the tree. The detection of their work is no difficult matter a short time after they begin feeding, for the leaves of affected twigs soon wilt and later dry up from the injury done to them.

The injury the first-brood larvae do to twigs, while sometimes alarming, is not usually to be compared with the injury to the fruit from the second and third broods. Often this injury to the fruit is extensive enough to render great quantities unmarketable. They usually enter the fruit from the stem end and may feed entirely within the flesh, but very often eat their way into the pits. Affected peaches may be detected by an issuance of sap mixed with little pellets from the fruit which have been chewed up by the larvae. This sap hardens on the outside and peaches so affected are often termed "gummy peaches."

The Pupal Stage.—This stage of the insect is said to last from six to twelve days, the first brood remaining pupae for the longest time. This period is passed by the first-brood pupae, according to Clarke, principally in curls of bark on the trunks of trees in very flimsy cocoons. They may, however, be found in other places, such as between two peaches which come in contact with each other, under rubbish on the ground, etc. The second and third-brood pupae more often pupate in the suture at stem-end of peaches than underneath the bark, and the semblance to cocoons is even less than in the case of the first brood.

The Moth.—The twig-borer moth is a tiny, gray insect, about ¼ inch in length

Fig. 3. Silken Tubes at Entrance to Larval Chamber in Crotch of Peach Twig.

and having a wing expanse of about ½ inch. It is quite beautiful with its dark-gray, fringed wings. They are very seldom seen in the orchards by the fruit growers, because of their small size, their close resemblance to projections of the bark and their habit of resting perfectly still during the daytime.

The Egg.—Eggs of this insect were first found by Marlatt, who kept the moths in confinement and found that they were deposited above the bases of the petioles of the leaves. Clarke found the eggs of the first brood in the orchard in the same location as described by Marlatt. He found, however, that the eggs of the second generation were laid not on the twigs, but on the fruit and in the edge of the stem-end depression; the eggs of the third generation were found in cracks of the bark, or exposed on its surface just above the crotches formed by the new wood and on the old wood.

The eggs are pearly white, changing to a deep yellow before hatching. They are quite conspicuous, being about 2/5 of a millimeter (1/60 of an inch) in length by 1/5 millimeter in breadth.

These observations of the egg and egg-laying habits of the insect made in California by Mr. Clarke, are very interesting, as they are the first recorded from studies made under the natural conditions of the orchard.

Remedies.—Experiments conducted by the writer in Colorado during the seasons of 1910 and 1911, and by Clarke in California, indicate that commercial lime and sulphur, used at the strentgh of 1 gallon to 10 of water, is an effective remedy for this pest. We have used it successfully both in the fall and spring. Earlier experiments conducted in this state by E. P. Taylor indicated that arsenate of lead used at the strength of 5 pounds of the paste to 50 gallons of water, and applied when most of the blossom buds showed their pink tips, would also result in their control.

George P. Weldon

Pear Scale. See *Pear Pests.*

Pear Thrips. See *Pear Pests.*

Plum Curculi. See *Plum Pests.*

Red Spider. See *Apple Pests.*

Rose Chafer. See *Rose Pests*, under *Floriculture.*

San Jose Scale. See *Apple Pests.*

San Jose Scale on Peach

Scurfy Scale. See *Apple Pests.*

Shot-Hole Borer. See *Apple Pests.*

Strawberry Crown Girder. See *Strawberry Pests.*

Striped Peach Worm

Gelechia confusella

The striped peach worm, recorded as doing serious damage in Michigan. The larva is described as "dirty white with six longitudinal, reddish-brown stripes, and with a yellowish-brown head and thorax. It wriggles violently when disturbed. It binds together the leaves with a web of fine silk, forming a nest of loosely bound leaves in which several

larvae live and in which they change to pupae." The caterpillars of the fall generation appear about the middle of September, reach their growth before the leaves drop and transform to pupae, in which state they pass the winter.

Either cut out and burn the nests, or, in case of early varieties, from which the fruit has already been picked, spray with arsenate of lead, just as the worms appear.

H. A. Gossard,

Ohio Agricultural Experiment Station Bulletin 233.

Tarnished Plant Bug
Stop Back on Peach

This is a grayish-brown bug, marked with black and yellow, and it is about one-fifth of an inch long. It is very common and attacks many cultivated plants.

Treatment

To protect the peach crop, clean culture is advised to keep down the weeds among the trees and about the margins of the orchard.

Tussock Moth. See *Apple Pests*.

Walnut Scale. See *Walnut Pests*.

Spotless Fall Web Worm
Hyphantria textor Harris
(Family *Arctiidae*)

General Appearance

The adults are slightly over one-half inch long with a wing expanse of one and one-half inches. The body is light and the wings pure or dusky white. There are no spots upon wings or body. This species is distinguished from the fall web worm (*Hyphantria cunea* Drury) of the Eastern states by the pure white antennae and the absence of spots on the abdomen. The full grown larvae are very hairy, yellowish or greenish in color, with a darker stripe along the back, a yellow stripe along the side and covered with whitish hairs which arise from black and orange-yellow tubercles.

Life History

This species hibernates in the pupa stage within a cocoon attached to tree trunks, fences, rubbish or under the ground. The moths emerge in the spring, mate and during the nights the females deposit from 400 to 500 eggs in clusters upon the leaves of the food plants. The caterpillars feed in colonies and spin webs large enough to accommodate all the members, which may include a large limb of a

Fig. 1. The Spotless Fall Web Worm (*Hyphantria textor* (Harris). Top, female; bottom, male. Enlarged. (Original.)

tree. When full grown the larvae leave the web and descend to suitable pupal quarters. There are two broods a year, the second appearing late in the summer.

Food Plants

This species feeds upon the foliage of a great number of wild and ornamental trees and shrubs, as well as upon fruit trees.

Control

The application of arsenical poisons, the collecting of the cocoons and the burning of the nests or webs containing the larvae with a torch are the remedies used against this pest.

Natural Enemies

Internal parasites play a very important part in the control of this moth.

E. O. Essig

West Indian or White Peach Scale
Aulacaspis pentagona Targ.

General Appearance

The scale of the adult female is circular with exuviae near one side, and gray in color. The male scales are elongate, white, and with distinct rib down the middle. They are longer than the diameter of the female scale.

Life History

The life history of this scale greatly resembles that of the rose scale (*Aulacaspis rosa*). There are three broods a year.

Food Plants

Peach, mulberry, plum, prune, apricot, walnut, geranium, cherry, pear.

Control

Same as for San Jose scale.

Natural Enemies

The two-stabbed ladybird beetle feeds upon this scale.

E. O. Essig

The Western Prune and Peach Root Borer
Sanninoidea opalescens Hy. Edw.

W. F. Wilson

Reported only from some four or five extreme Western states, we have another insect which so closely resembles an Eastern species as to be distinguishable only by the absence of a distinct orange-colored band across the abdomen. Perhaps very few orchardists have ever seen the adult of the borer, although every peach and prune grower has no doubt had the pleasure of digging out the larvae from the roots of his trees. The habits of our Western species vary only in a few immaterial differences from those of the Eastern. The borers of both seem to attack trees to a greater extent in light sandy or gravelly soils. Peaches are most susceptible to attack, although prunes and apricots seem to be a close second. Almonds, cherries, apples and native plums may be attacked. Myrobalan plum trees are but very little bothered under normal conditions and should be used as stocks upon which to graft domestic plums.

The adults or moths emerge in midsummer; at that time they are metallic-black in color, fore wings transparent with black margins; hind wings transparent with a black border. Under side of wings same as upper. They may often be seen resting on leaves or trunks of trees. Soon after emergence the sexes mate and as soon as copulation takes place the female moths begin to lay their eggs on the bark close to the crown of the tree. Oviposition is finished in a few days and then the moths die. The egg state lasts about two weeks and the newly hatched larvae start in at once to locate suitable places for entering the bark. Within a couple of hours they are able to disappear under the frass thrown out

Fig. 1. Prune and Peach Root Borer; 1, larvae in burrows taken from peach tree; 2, cocoon pupal case and adult. (Original)

in starting their burrows. The majority of the larvae work below the surface of the soil before entering the bark and will always enter an old burrow if one is handy. In rare instances larvae may be found working in the trunk and larger branches. Under the bark the larvae work upward or downward and may work up the trunk as far as twelve to sixteen inches, eating away all of the sapwood. One tree may have as many as seventy borers working on it at one time. Apparently the larvae feed at random, as there is no regular shape to the burrow; they may be long, wide, narrow, large or

small, and more than one borer may be found in the same burrow. As fresh castings can nearly always be found at the opening the larvae evidently clean house every day. This mixed with the gum nearly always indicates where burrows can be found. When full fed the larvae leave the main part of their burrows, seek places where the adults can escape, form cocoons out of silken threads and chewed bark or pieces of soil, line them with silk and pupate. The cocoons are elongate oval in shape and about an inch in length. Pupation usualy takes place about June 1, the pupal stage lasting about four weeks.

Remedies and Preventives

At Cornell, where a four-year test of eighteen or twenty preventives was tried, the best preventives were: gas tar daubed on the bark, waste tobacco stems and leaves wrapped around the tree, tarred or other paper wrapped about the trunk. Relative value in the order named. At Corvallis good results were obtained by use of whitewash and Paris green and thick Bordeaux and Paris green.

There are two chief difficulties in the digging out method. 1. At whatever period one does the work, there will be many small larvae which will be undiscovered, thus necessitating for the best results that one go over the trees two or three times during the season. 2. It necessarily does more or less injury to the tree. According to Cornell results, however, this is the only satisfactory method that can be used, and should be supplemented with one of the preventive methods.

The United States Bureau of Entomology now recommends three formulas which are being used in various parts of the country against borers. They should be applied just after worming.

"*Formula No. 1*—The lime-crude-oil mixture; place about fifty pounds of rock lime in a barrel and slake with ten or fifteen gallons of warm water; while the lime is boiling, slowly pour in six to eight gallons of heavy crude oil and stir thoroughly. Add enough water to make the whole a heavy paste. The wash should be applied immediately with a heavy brush.

"*Formula No. 2*—The lime-sulphur-salt mixture. Place about twenty-five pounds of rock lime in a barrel and slake with warm water. Add two quarts of sulphur and two or three handfuls of salt while the lime is still boiling. This wash is heavy and is applied with a brush.

"*Formula No. 3*—Lime, coal tar and whale-oil soap. Unslaked lime fifty pounds, coal tar one and one-half gallons, whale-oil soap twelve pounds. Slake the lime in warm water and add the gas tar while the mixture is boiling; dissolve the soap separately in hot water and add this to the lime solution. Add enough water to make a heavy paste."

Asphaltum Treatment for Peach Tree Borer

* In a recent bulletin of the California station E. L. Morris calls attention to the use of hard asphaltum, grades "C" and "D," for the control of the peach tree borer. This material was applied early in the spring to badly infested trees from which the borers had been dug.

It was found that thick, heavy coating prevented both the issuance and the entrance of about 95 per cent to 98 per cent of the insects, the degree of efficiency depending upon the thoroughness of the application. Asphaltum does not penetrate, crack, deteriorate, or bind the tree, since it yields to the slightest pressure. Four years of experimenting have not shown the least injury.

The material is applied warm with a brush from five inches below to five inches above the ground. It is easier to apply two or more coatings than to try to put on more at one time than will adhere firmly. The first coating will harden very quickly and the second can be applied without loss of time. Two coatings are generally sufficient unless the bark is very rough. But in any case a thick, uniform covering is absolutely necessary for the best results.

Borers are seldom uniformly distributed over an orchard. Small blocks of trees here and there may be badly infested and the most of the orchard com-

*U. S. Department Agriculture Farmers Bulletin 517.

paratively free from the pest. In such cases it is not necessary to treat all of the trees with asphaltum, but it is necessary to examine them carefully, for in no other way can the true conditions be known.

A convenient way to handle the asphaltum is to mount an iron kettle on the running-gear of an orchard truck and sus pend beneath it a sheetiron apron as a firebox. Keep hard asphaltum in the kettle all the time, so that the melted asphaltum will not get too hot to carry in small containers, and apply directly to the trees.

Peanuts

Arachis hypogea

It is not definitely known when and where the peanut was first cultivated. Several allied species of plants are natives of Brazil, and there is every indication that the common peanut originally came from tropical America. Peanuts were introduced into the United States during the earlier days of colonization, but did not become of commercial importance until about 1870. From that time until 1897, the growth of the peanut industry was gradual, but a great increase in the production and use of peanuts has taken place during the last eight or ten years.

Botanically the peanut belongs to the same group of plants as do the beans and peas, but it possesses the character of maturing its fruit or nut beneath the surface of the soil, rather than above ground as do most other leguminous plants.

The technical name of the peanut is *Arachis hypogea*, the name indicating the characteristic habit of the plant to mature its fruits underground. The peanut is known under the local names of "goober," "goober pea," "pindar," "ground pea," and "groundnut." The names "goober" and "goober pea" are more properly applied to an allied species, having no true stem and only one pea in each pod, which has been introduced and is frequently found growing wild in the Gulf Coast states. Properly speaking, the peanut is a pea rather than a nut, the term "nut" having been added on account of its flavor, which is similar to that of many of the true nuts.

The small yellow flowers of the peanut are borne in the little pocket where the leaves are attached to the stems, and as soon as pollination has taken place the visible portion of the flower fades and falls, after which the short, thick stem that supports the lower portion of the flower elongates and the sharp-pointed ovary is thrust downward into the soil, where the pod develops. Should the ovary fail to reach or penetrate the soil no pod will be formed.

The value of the commercial peanut crop of the United States for the year 1909 was $18,271,929. During recent years the area of production of peanuts has greatly increased, especially throughout the warmer parts of the country. The value of the peanut, both as a money crop and for feeding on the farm, renders it especially desirable as a part of the rotation wherever conditions suitable to its development exist.

Most persons think of the peanut as it appears for sale at the news and fruit stands, but during recent years many new lines of consumption have been found. In addition to the great quantity of peanuts sold in the shell each year, thousands of bushels are shelled for use in the manufacture of confections and food products.

The peanut is well adapted for use as a part of the cropping system in the Southern states, especially on the cotton and tobacco lands. Soils that will not produce more than one-fourth of a bale of cotton to the acre can be made to yield a fair crop of peanuts at a very low cost for growing. Comparatively few persons realize the value of peanuts when used as a farm crop, especially when the product is fed to live stock on the farm and eventually returned to the soil in the form of manure.

Soil and Climatic Requirements of the Peanut

The soil best suited to the peanut is one of a sandy, loamy nature, preferably light or grayish in color rather than dark. Soils that are dark and those carrying a considerable percentage of iron or other

mineral are likely to stain the shells of the peanuts, thus rendering them less desirable for the trade. For agricultural purposes, however, the staining of the shells is of little consequence, as it does not materially injure them for stock feeding. In fact, soils that contain considerable clay and lime or are loamy in character produce heavier nuts and sometimes greater yields than do lighter soils. As a rule the peanut does best on a sandy loam with a well-drained clay subsoil, but the crop may be grown under a wide range of soil conditions. Soils that become hard or compact are not adapted to peanut growing, owing to the inability of the pod stems or "pegs" to penetrate the surface.

Soils that are poorly drained or sour are not suited to the peanut. The ideal soil consists of a sandy loam containing a reasonable amount of humus, or vegetable matter, together with an abundance of lime. A soil having a suitable mechanical consistency is the first essential. Soils lacking in fertility can be improved by a proper cropping system or by the judicious use of manures.

The cultivation of the peanut for commercial purposes has until recently been confined chiefly to areas in Virginia, Tennessee, the Carolinas and Georgia. During recent years the industry has become established throughout the South Atlantic states and westward to and including California. This area is one within which the frost-free season is comparatively long, and much of the territory has a soil containing a large percentage of sand or alluvial matter, making it easily cultivated and well adapted to the peculiar habits of the peanut plant. There are undoubtedly many sections outside of this area that can be profitably devoted to the production of peanuts for stock food, and a few regions where they can be grown commercially.

The climatic requirements of the peanut are a long season without frost, a comparatively light rainfall during the growing period, abundant sunshine, and a high temperature. The peanut is slightly more susceptible to injury from frost than the common bunch bean and requires a somewhat longer season for its development. The Spanish peanut will mature in 90 days under the most favorable conditions, but 110 to 120 days should be allowed. The large-podded varieties require a longer period for best results.

Preparation of the Soil

Time for Plowing

The time for plowing the land to be planted to peanuts will depend somewhat upon its previous treatment. If the land has been in corn the season before and a crop of crimson clover was sown at the time the corn was laid by, it will be desirable to plow the land just before the clover blooms in order to get the greatest benefit from it as a green manure. If the land is in sod it will be desirable to break it during autumn or winter. If there is no crop on the land the plowing need only be done in time for planting, or rather but a short time before planting, in order to allow the soil to settle. Where a crop of crimson clover is turned under, the soil should be thoroughly harrowed and rolled in order to obtain a compact seed bed and to retain moisture.

Depth of Plowing

The depth of plowing will depend somewhat upon the character and depth of the surface soil. On sandy soils that are underlaid by a clay subsoil it would be unwise to bring a very great quantity of the subsoil to the surface. If the surface soil is not of sufficient depth, it should be increased by plowing a very little deeper each year until a sufficient depth is reached. As a general rule the depth of plowing for peanuts should not be quite so great as that for corn in the same locality. From five to seven inches of loose soil will be sufficient for the growing of all varieties of peanuts. Subsoiling may prove beneficial on soils having insufficient drainage.

Preparation for Planting

When the land is plowed but a short time before planting it should be harrowed within a few hours after plowing, in order to prevent loss of moisture. On loose, sandy soils that are reasonably free from weeds or grass it is often possible

to dispense with the regular plowing and cut the land with a disk harrow or disk plow. This implement both cuts and turns the soil, leaving it in fine condition, so that it is readily prepared for planting. Where plowing is necessary in order to turn under sod, clover, or weeds, a tool of the Acme harrow or Kimball cultivator type is desirable for smoothing and pulverizing the soil afterwards. This harrow is superior to the ordinary smoothing harrow in that it turns, crushes and levels the soil in one operation. If the soil is very loose it may be necessary to roll or drag thoroughly before planting.

Under ordinary circumstances level culture should be practiced, but where the drainage is poor it may be advisable to throw up slight ridges upon which to plant peanuts; this is especially desirable during a season of excessive rainfall. When ready for planting, the soil should be in the same general condition as that prepared for a crop of snap or bunch beans. Thorough preparation of the soil is profitable for all crops, and especially for peanuts. If the soil can be harrowed once a week for three or four weeks before planting, most of the weeds that would otherwise injure the crop will be destroyed.

Fertilizers and Preparatory Crops

Cropping System and Green Manures

Peanuts should be grown in rotation with other crops rather than as a specialty. The cropping system will depend somewhat upon the area of other crops grown, but the arrangement should be such that the land will be planted to peanuts one year in each three or four. A good rotation is corn or cotton the first year with cow peas planted between the rows at the time of the last cultivation; the next season plow under the remains of the cow peas and plant the land to peanuts; as soon as the peanuts are harvested sow the land with rye and use as a winter pasture; plow under the rye during the springtime and plant cow peas, using the peas as a hog pasture during the autumn; then return to corn or cotton the following year.

Another plan would be to devote the land one year to sweet potatoes instead of cow peas, or to a crop of early Irish potatoes followed by cow peas or crimson clover. In this rotation stable manure should be applied to the crop of corn or cotton, and the commercial fertilizers with the peanut and potato crops. Peanuts should invariably follow some well-cultivated crop which has been kept free from weeds.

The Use of Stable Manure

Stable or barnyard manure should not be used as a fertilizer the same year that the land is planted to peanuts owing to the great number of weed seeds that are contained in the manure. The use of manure also has a tendency to cause the plants to produce abnormal tops and a large percentage of poorly filled pods, known to the trade as "saps" or "pops." The proper time for applying stable manure is with the crop grown the previous season, thus giving it time to become incorporated with the soil and reduced to the proper condition for the peanut crop.

Commercial Fertilizers

The peanut responds to the use of commercial fertilizers. However, a reasonable amount of humus in the soil is essential. If properly handled, the peanut crop is not exhaustive of soil fertility; in fact, the plant is a great nitrogen gatherer, as may be observed by the large number of nodules upon the roots. On the other hand, if the entire plant, including the root, is removed and no part returned to the soil, the peanut becomes almost as exhaustive of soil fertility as cotton or corn. By feeding the straw and other refuse from the crop to cattle, hogs, and work animals and applying the manure thus obtained to the land the fertility may be retained or even increased.

On soils that are adapted to the production of peanuts it will not be necessary to employ commercial fertilizers in large quantities. Soils abundantly supplied with nitrogenous matter will, especially during a rainy season, produce an overgrowth of vine and poorly filled pods.

A commercial fertilizer adapted to the production of either Irish or sweet potatoes is as a rule suited for the growing

of peanuts. A mixture which contains from two to four per cent of available nitrogen, five to seven per cent of available phosphoric acid, and six to ten per cent of potash is desirable; this should be applied at the rate of from 200 to 1,000 pounds to the acre, according to the needs of the land. Most growers follow the practice of scattering the fertilizer in a narrow strip where the row is to be planted, but for the general good of the land it is a better plan to sow or drill the fertilizer broadcast. In all cases it is important that the fertilizer be thoroughly mixed with the soil.

Importance of Lime in the Soil

In order to insure the proper filling and ripening of the pods, peanuts require an abundance of lime in the soil. Where the soil is of a calcareous nature, containing limestone, shells, or lime in its more active form, it may be necessary to make a regular application, but on soils that are deficient in lime or inclined to be in the least sour, from 1,000 to 2,000 pounds of fresh-burned lime should be applied to an acre every four or five years. The lime should not be put on at the same time as the commercial fertilizers, but rather during the previous autumn, or at the time of plowing the land. Wood ashes are desirable as a fertilizer for peanuts, as they contain both potash and lime. Unleached wood ashes may be applied broadcast at the rate of 1,000 to 1,200 pounds, 25 to 30 bushels to the acre.

The presence on the land of certain weeds, such as the common sorrel and the sedges (which have three-cornered stems), indicates sourness and insufficient drainage; to correct this an application of lime will be necessary in addition to ditching or tile draining. Lime should be used on land that is to be planted to peanuts, unless it is definitely known that there is an abundance of it already present.

The Peanut as a Nitrogen Gatherer

The peanut plant, in common with other leguminous plants, has the power of collecting the free nitrogen of the atmosphere and storing it in little nodules upon its roots. For this reason the peanut is one of the more desirable of our soil-renovating and soil-improving plants. It should be borne in mind, however, that in order to benefit the soil the nitrogen so gathered should not be removed, but that the main portion of the roots should be left in the soil. Fig. 1 shows the root of a peanut plant which is abundantly covered with the nitrogen-storing nodules.

Fig. 1. Roots of Peanut Vine, Showing the Value of This Plant as a Nitrogen Gatherer. The nodules on the roots are formed by the bacteria which collect the nitrogen.

The Seed and Its Selection

Importance of Planting Good Seed

A good grade of seed is just as important with the peanut as with corn, wheat, or any other crop. There is perhaps no other farm crop except corn that is so greatly influenced by the character of seed planted as the peanut. The very best peanuts of the previous season's crop should be selected for seed, and of these only the most mature and perfect peas should be used. Seed should be saved only from well-ripened and mature plants and should be properly cured and kept dry during the winter months. Good seed produces a more even stand of plants, which in itself returns a greater yield.

Improvement by Selection

The seed should not only be selected from plants that are mature, but from those producing a large number of mature pods as well. By doubling the number of well-filled pods on each plant the yield for each acre will also be doubled. Many millions of bushels have been added to the corn crop of the country simply through the selection and improvement of seed.

What has been done with corn is possible with the peanut, and where we now have an average yield of 34 bushels to the acre it is reasonable to expect this to be increased to 50 or 60 bushels through seed and cultural improvements.

Planting Shelled or Whole Seed

In planting the large-pod varieties it is desirable for several reasons that the seed be shelled. In the first place the planting machines now in general use are adapted to handling the shelled seed only. Second, when planting whole pods there is always a doubt regarding their being well filled, and a poor stand may result. Third, pods containing two or more seeds will produce more than one plant in a hill, causing a waste of seed and a crowding together of the plants. Fourth, whole seed is slower in germinating than shelled seed. With the Spanish variety the case is quite different, as several of the machines will handle the whole nuts, the pods are invariably filled, the crowding together of the plants is no great disadvantage, and the few days extra time required for germination is of little consequence.

Virginia nuts intended for seed should always be shelled by hand, but the Spanish are sometimes shelled by machinery, although their germination is invariably injured when so handled. Many growers of the Spanish peanut practice soaking the unshelled nuts in water previous to planting. Soaking for a few hours will hasten germination, but if for any reason the seed can not be planted immediately it will be lost. Shelled seed should never be soaked before planting.

Time and Methods of Planting

The time for planting peanuts is in the spring after the soil has become thoroughly warm. In order to secure a good stand, the seed should not be put in the ground until there is sufficient warmth to germinate it quickly. As a rule peanuts should be planted a trifle later than corn and beans. The Spanish variety may be planted somewhat later than the Virginia type, as it requires less time to complete its growth.

Distance to Plant

A common distance between rows is 36 inches, but this varies somewhat according to the soil and variety. For the Virginia Runner variety on good soil the distance between rows should be at least 36 inches, and 12 inches between the plants in the rows. Virginia Bunch peanuts may be in rows as close together as 30 inches, and seven to nine inches apart in the rows. The Spanish and Tennessee Red varieties are planted in rows from 28 to 36 inches apart and 7 to 9 inches apart in the rows according to the fertility of the soil. On rich soils, where the spread of vine will be great, the maximum distance between rows as well as between plants in the row should be allowed.

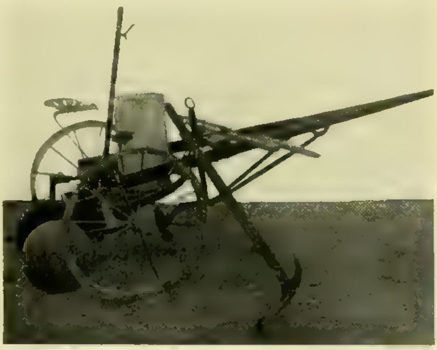

Fig. 2. Machine for Marking Land and Sowing Fertilizer.

Quantity of Seed Required

The quantity of seed peanuts required to plant an acre will depend somewhat upon the distance of planting. As a rule one-half bushel of shelled Virginia peas

will plant an acre. One and one-half pecks of shelled Spanish peanuts, or two bushels in the pods, are required for an acre. The greater the care exercised in planting, the smaller will be the waste of seed, and economy is quite an object when planting specially selected or high-priced seed.

Depth to Cover the Seed

The depth to which the seed should be covered will depend somewhwat upon the character of the soil. On heavy soils three-fourths of an inch to one and one-quarter inches will be sufficient, while on light soils one and one-half to two inches may not be too deep.

Tools and Methods of Planting

Peanuts are generally planted in rows that are cultivated in one direction only. Some growers follow the practice of first marking the land with an implement similar to the ordinary corn marker. Others open a furrow with a one-horse plow, then after the fertilizer has been distributed in the furrow the plow is again used and a slight ridge thrown up. There is now on the market a tool of the type shown in Fig. 2, which sows the fertilizer, throws up a slight ridge, and at the same time indicates the position of the next row. If desired, this machine can be supplied with a seeding device, which will complete the planting at one operation.

The greater portion of the peanut crop is planted with the one-horse planters of the type shown in Fig. 3. These machines are similar in many respects to a cotton planter; in fact, a cotton planter may be adapted to planting the whole Spanish or the shelled Virginia peanuts with very little trouble or expense. The ordinary peanut planter costs in the neighborhood of $15 in most localities.

General Cultivation
Method of Cultivation

Cultivation of the peanut crop should begin as soon as the rows can be followed and continue until the vines begin to occupy the ground. The work of cultivation should be pursued very much the same as for corn, beans, and all similar crops. Frequent shallow cultivation that will keep the soil loose and prevent the loss of moisture is essential. Shortly after rains the surface soil should be stirred and during dry weather a dust mulch maintained. After the first cultivation it will be desirable to work the soil toward the rows to provide a bed of loose earth in which the pods may form.

After the peanuts begin to "peg," or form pods, they should not be disturbed or given further cultivation. The old idea that the blossoms of the peanut must

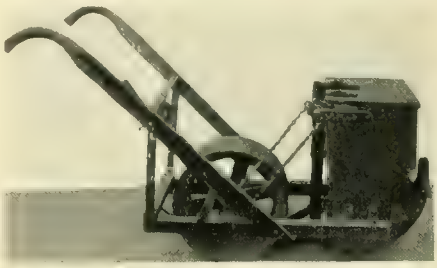

Fig. 3. Peanut Planter.

be covered is erroneous, although growers frequently allow considerable soil to be thrown over the vines during the final cultivation. For the last cultivation it is a common practice to employ a tool that will both throw the soil toward the rows and leave a furrow in the middle of the alley to carry off the water during heavy rains.

Tools Adapted to Cultivating Peanuts

Most implements that are adapted to the cultivation of corn or cotton will be found suitable for handling the peanut crop. For the first two or three cultivations a spring-tooth riding cultivator is desirable, while for the later workings the same implement can be used by changing the spring teeth for regular cultivator shovels. For one-horse cultivation the ordinary cotton sweep is frequently used, but the five-tooth cultivator will do more efficient work. This implement is provided with several styles of narrow and broad shovels, sweeps and hillers, making it adaptable to a great many changes and suited to a wide range of conditions.

Some growers follow the practice of running a light roller over the plants

Fig. 4. Peanut Digger.

after the final cultivation, the object being to flatten the stems upon the ground in order that the little pods forming on the extremities of the stems may reach the soil. This practice may increase the yield, but it will also increase the percentage of "saps," or unfilled pods, and it is doubtful if anything is gained by the practice.

Harvesting

Proper Time for Digging the Crop

No fixed rule can be given by which to determine when to remove the peanut crop from the ground, and each grower must be his own judge in the matter. In general practice the growers aim to dig before the first frosts, in order that the peanut vines may have greater value for stock food. To the southward, where frosts do not appear until quite late, the vines assume a yellowish appearance during the latter part of the season, which indicates the ripening of the peas. If digging is deferred too long, the first-formed peas are likely to burst their shells and start growing; this is especially true if there is a period of rainy weather late in the season. The aim should be to dig at the time the vines have upon them the greatest number of mature peas. Where a large acreage is grown it will be necessary to begin harvesting as soon as the earliest peas are ready, in order to complete the work before unfavorable weather sets in.

Methods Employed for Lifting the Plants

Under ordinary circumstances the peanut vines are plowed from the ground with a one-horse turning plow and afterwards separated from the soil by hand. Many growers employ either a two-horse plow similar to that frequently used for digging potatoes or a turning plow with the mold-board removed to prevent a furrow being turned. Behind the digger or plow a gang of workmen shake the vines and peas free from the soil and throw them in small bunches. In this manner a team and driver accompanied by eight or ten hands will dig from five to seven acres a day at a cost of about $2.50 an acre.

It has been found by experiment that the regular machine potato digger drawn by two or three horses driven by one man will dig from 8 to 12 acres a day and do the work in a much cleaner and better manner than the old plow and hand method. This machine not only removes the peanuts from the ground in a more perfect manner but also shakes off the soil and leaves the vines lying loosely upon the surface of the ground. By the hand method a great many pods become detached from the vines, while with the machine potato digger scarcely a pod is lost. A machine of this character is shown in Fig. 4.

Special machines are now being offered which are intended to dig, clean, and bunch the peanuts. By setting any of these machines to the proper depth it is possible to sever the main root of the peanut just below where the pods are formed and thus leave considerable of the accumulated nitrogen in the soil. It is estimated that the nitrogen left in the soil by this system has a fertilizing value of from $3 to $4 an acre.

Curing Process and Care of Crop After Digging

After the peanut vines are loosened from the soil they are allowed to lie either spread upon the ground or in small bunches for three or four hours, and are then placed in small stacks around a central stake to cure. If the peas are allowed to lie exposed to the weather for any length of time after digging, the pods become discolored and loose in weight.

A better grade of peanut hay will be secured if the vines are placed in the small

stacks as soon as the leaves and stems are thoroughly free from dew or from other moisture. Most growers follow the practice of putting the peas in shock the same day they are removed from the soil, or those dug during the morning are stacked in the afternoon and those dug later in the day are stacked the following morning as soon as they are free from dew; however, any dew or rain will discolor the pods.

The essentials in caring for the crop during the curing period are that the peanuts be kept in small stacks, given an abundance of air, and protected from both the weather and injury from animals. Owing to the fleshy nature of the stems they cure quite slowly and are liable to mildew if placed in large lots.

In order to produce a good grade of peanuts for the market it is necessary to cure them in small stacks built around a central stake or pole. The supply of stakes should be ready in advance and may be kept for use from year to year. These stakes should consist of split or round poles about three or four inches in diameter, seven feet in length, and sharpened at both ends. For setting the stakes in the ground a pointed bar of iron or a crowwbar with which to make the holes is necessary. The stakes should be set in the ground to a depth of 12 to 18 inches and well tamped to make them firm and solid. Before starting the shock one or two pieces of lath are nailed across the stake a few inches from the ground, in order to prevent the peanuts coming in direct contact with the soil. In starting to build the shock a few vines are laid across the pieces of lath and the shock then built up by successive layers of vines, the pods being kept well to the center and the tops to the outside. The stems should have sufficient outward slope to shed water. Occasionally a few vines should be hung around the stake in order to tie the shock together. By this method the pods will be near the center and around the pole, where there is an upward circulation of air and general protection. When the shock has reached the desired height, a bunch of vines is rolled together and pressed down over the point of the stake to form a top, or a little grass or weeds may be used for this purpose.

Fig. 5. Negro Stacking Peanuts.

Storage in barns is not advisable when curing peanuts for market, but where the entire plant is fed to stock the crop may be handled in much the same manner as cow peas, velvet beans, or a heavy growth of clover.

Picking and Cleaning

Peanuts for market should be cured in the shock at least three or four weeks before picking. If the weather is dry and windy immediately after harvesting, the curing process will be quite rapid, but should the weather conditions be unfavorable during this period the pods will ripen more slowly. Too rapid curing is not desirable, as the pods are likely to shrivel and discolor. Peanuts should not be picked from the vines until the pods have become dry and the peas firm and nutty, with the immature ones more or less shrunken. As a rule very little is to be gained by early marketing, and a better grade of peanuts will be secured

if picking is deferred until late autumn. If the pods are not well protected in stacking, many will be destroyed by the common blackbird. In some sections it is necessary to pick as early as possible to prevent heavy loss from the ravages of field mice and rats while the peanuts are in the shock.

If peanuts are not well stacked the pods are liable to become discolored by the heavy fogs and driving rains of late autumn. The stacks should not be opened or the vines handled during wet weather.

Picking by Hand

The standard of excellence in the peanut markets is always based upon hand-picked stock. Peanuts that are picked by hand now bring a higher price than those picked by machinery, but with the present scarcity of labor and rapid improvement in peanut-picking machinery the time will soon come when a uniform price will be paid for a given quality of peas regardless of how the picking is done.

In some localities the pickers are paid by the hundred pounds, 40 cents a 100 being the average price paid. At this rate the cost of picking the peanuts grown on one acre will vary from $4 to $8.

Use of Machines for Picking

Two types of machines have been employed for picking peanuts from the vines, and most of the work done by them has been quite satisfactory. A cylinder machine similar to a regular grain separator except as to size has been used for several years, especially in the districts where the Spanish variety is extensively grown. The principal objection to all the cylinder machines is the tendency to break the pods and both shell and injure the peas. By running the cylinder quite slowly, say at 400 revolutions a minute, and feeding properly, it is possible to thrash peanuts by using a cylinder machine with a very small percentage of loss from breakage. Pods that are merely cracked or that have what the growers term "oyster mouths" will not keep for a long period but become rancid or are injured by small insects while in storage.

There is a machine in use which works upon an entirely different principle from the cylinder machines and which does not break or injure the pods. In this machine the picking is done by dragging the vines over a horizontal wire mesh, and at the same time brushes act on the lower side of the wire screen to remove the nuts. Very little power is required to operate this machine, two complete outfits being run at once by a five-horsepower gasoline engine. The capacity of this machine is from 300 to 500 bushels a day. In addition to removing the pods from the vines the machine has the usual cleaning arrangements and a device for removing the small stems from the pods, delivering them in a condition suitable for the cleaning factory. Fig. 6 shows one of these machines in operation.

Care of Peanuts After Picking

At no time after the curing process should the peanut pods be exposed to

Fig. 6. Peanut Picking Machine in Operation. Improved Type.

water, or even dampness, as the shells invariably become darkened and discolored by the addition of moisture. When properly cured the shells will be covered with a fine, dry dust, and where this dust becomes moistened it adheres and forms a brownish spot. If the peanuts show the least trace of dampness after their removal from the vines, they should be spread on a floor or stored in a well-ventilated building until thoroughly dry. Many of the larger growers have provided narrow cribs similar to those employed for the storage of corn, and the peanuts are kept in bulk until sold. When the pods are thoroughly dry they may be put into bags as they come from the machine, and either hauled direct to the cleaning factory or stored in small lots.

Preparation of Peanuts for Market

As the peanuts come from the hands of the pickers or the thrasher they contain considerable rubbish and have more or less adhering to the pods. The extent to which the pods must be cleaned and graded will depend upon the use to which they are to be put; if for vending purposes they will require a factory process, but if for shelled nuts very little work will be necessary to prepare them for the sheller. Under the present status and extent of the peanut industry the cleaning factory has become an important factor, and the interests of the grower and cleaner are correlative and should be co-operative. Where Spanish peanuts are grown on an extensive scale it may be feasible for the farmer to own and operate a small shelling and cleaning outfit. In the case of the large-podded varieties several grades are made from one class of stock, requiring an extensive, although simple, equipment and the handling of large quantities of nuts in order to make the enterprise profitable.

Methods of Cleaning Peanuts in the Factory

The cleaning or factory process consists chiefly in the removal of all dirt and the separating of the nuts into their respective grades. In addition to grading, the higher class product is treated to a polishing process, which gives the pods a more attractive appearance when exposed for sale. The modern peanut-cleaning factory consists of a four or five-story building, which is supplied with power, lighted by electricity and provided with elevators and bins for handling and storing the unclean nuts. It also has a full equipment of fans, grading machines, polishing drums and shellers, and an abundance of lower-floor space for the storage of the bags of nuts that are ready for marketing.

When the peanuts are received from the farmer at the factory they are weighed and then elevated to the top floor of the factory. During the cleaning and grading process they descend by gravitation through the fans and graders, are tumbled in the polishing drums together with a small quantity of marble dust to whiten and polish the pods, are passed on slowly moving belts between lines of women who are expert in detecting foreign matter and inferior nuts, and finally drop into bags on the lower floor.

In the modern cleaning factory all dust and refuse is removed by means of fans and ventilators, the portions of sticks, stems and broken shells being conveyed to the boiler room and fed into the furnace. One advantage of a factory process is that nothing need be wasted, as all broken or split peas can be worked into the stock used in the manufacture of peanut products.

Cleaned Vines as Stock Food

The peanut vine or straw from which the nuts have been removed is of considerable value for feeding purposes. Where the peanuts are picked from the vines by hand the stems become broken and the greater portion of the leaves is lost, but where machines are used for picking it is possible to save the straw in fairly good shape. If the vines are carefully handled during the curing process and then put in barns or stacks that keep out rain, the straw when delivered from the thrasher will have a feeding value about equal to clover hay. If the vines are bright and clean after the pods have been removed they can

either be sold or fed to farm animals, and they will in this way partially pay for the cost of planting and cultivating the crop. Some growers employ a baling press and bale the straw as it comes from the thrasher in order that it may be more easily stored and also be available for marketing.

VARIETIES OF PEANUTS

There are not more than five or six distinct varieties of the peanut grown in the United States, but these few varieties represent at least three separate types. By classifying the varieties of peanuts according to types we have first the large-podded or Jumbo peas and the small-podded peas. These types are subdivided into bunch and running peas. Fig. 7 shows pods and peas of the more important commercial varieties.

Those varieties having a bunch habit of growth are most generally grown, owing to the fact that they may be planted closer together than the running varieties. The bunch varieties are also more easily cultivated and harvested than are the runners.

Descriptions of Varieties

The following descriptions of the more common varieties of the peanut may be of interest to those not already familiar with them:

Virginia Bunch

Large-podded variety; plant rather dwarf, stems upright, foliage rather light; pods clustered about the base of plant; usually two, sometimes three, seeds in a pod; pod bright and clean, color of peas light brown; pods adhere well to plant in digging. The customary weight per bushel of this variety is 22 pounds. (Fig. 8, and Fig. 7 A.)

Virginia Runner

Large-podded variety; strong grower; stems creeping, foliage heavy; pods scattered along procumbent stems; pods and peas very similar to those of the Virginia Bunch; pods do not adhere well in digging. The customary weight per bushel of this variety is 22 pounds.

North Carolina

Similar to Virginia Runner, except that plant is not so large or vigorous and pods and peas are both smaller. This variety contains a high percentage of oil. (Fig. 7 B.)

Spanish

Small-podded variety; strong grower; stems upright, foliage abundant and heavy; pods clustered about base of plant; usually two seeds in a pod, entirely filling the pod; pods rough and inclined to be darkened in color; color of peas light brown; pods adhere well to plant in digging. This variety frequently yields 60 bushels of marketable peas and two tons of hay to the acre. The peas of this variety are rich in oil content. The weight per bushel of Spanish peanuts is 28 pounds. (Fig. 7 C.)

Tennessee Red

Small-podded variety; similar to Spanish, except that the pods are longer, sometimes containing five or six peas crowded together; peas dull red in color. This variety is well adapted to stock feeding, but does not sell upon the market owing to the color and quality of the peas. (Fig. 7 D.)

Dixie Giant

The variety known as Dixie Giant is so called owing to the great size of its pods. It is distinctly a novelty, does not

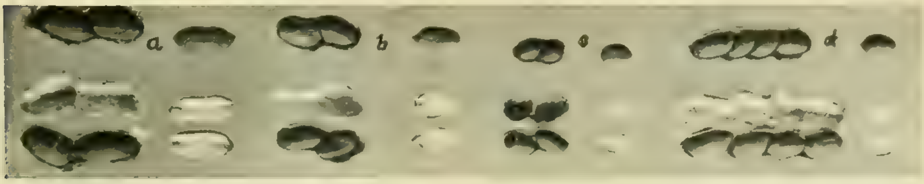

Fig. 7. Commercial Types of Peanuts. A, Virginia Bunch or Virginia Runner; B, North Carolina; C, Spanish; D, Tennessee Red.

Fig. 8. Virginia Bunch Type of Peanut.

yield well and requires a long season for the pods to mature. Recommended only for southern part of Gulf Coast states. The peas of this variety are very large and are desirable for the manufacture of fancy blanched nuts.

Varieties for Marketing

For vending purposes, where the peas are roasted and sold from the fruit stands, the large-podded varieties, including Virginia Bunch and Virginia Runner, are in great demand, although considerable quantities of Spanish and North Carolina are used for this purpose. For shelled peas the smaller nuts of the large-podded stock are employed; also the greater part of the crop of Spanish, North Carolina and Tennessee Red varieties. A large percentage of stock that is shelled is of the variety known as Spanish.

Varieties for Stock Feeding

When peanuts are grown exclusively for feeding purposes the Spanish is undoubtedly to be preferred. If it is desired to market the high-grade portion of the crop and feed the remainder, the question of variety to be grown will depend largely upon locality. Many growers throughout the peanut area follow the practice of planting several acres of Spanish peanuts and disposing of all of the better-grade peas to some factory for shelling purposes, the vines and poorly filled pods being fed to the farm animals.

The Spanish peanut can be grown under a much broader range of conditions than can the large-podded sorts, and should be employed where the season is short.

This variety also produces a heavy yield of vine and is desirable for forage purposes. The Tennessee Red is very similar to the Spanish in habit of growth and is desirable for stock feeding, but as this variety does not sell readily upon the market it is not generally recommended.

USES OF THE PEANUT

To most persons the peanut suggests only the article as it appears for sale whole or shelled and salted, but during recent years the uses of peanuts have become numerous, and include a wide range of utility. The demand for peanuts for use in the manufacture of food preparations is constantly increasing. By-products of the peanut are now being employed extensively in the manufacture of feeds for farm stock and dairy cows, and the plant is being largely utilized as forage and as a soil renovator.

Important uses for human food are the following: It is eaten from the shell, as salted shelled peas, as blanched peas, in the so-called peanut candies and brittle, in combination with popcorn and puffed rice, in the form of peanut butter, and as an ingredient of peanut and vegetable meats, peanut meal and salad oils.

The use of the peanut for eating from the shell when roasted is most important and popular, but the quantity of shelled peas that are first roasted and then salted and sold by the pound is constantly increasing.

A comparatively small quantity of the better grades of peanuts is first shelled and then roasted and the thin brown covering removed, after which the halves of the peas are broken apart, the small germ removed and the meats given a blanching process which renders them very desirable for table use.

Greater quantities of shelled peas are used every year in the manufacture of peanut candies and brittle, both alone and in combination with other nuts, popcorn or puffed rice. A very desirable

kind of peanut candy can be made by simply boiling shelled peanuts with a thick syrup consisting of two pounds of granulated sugar and one large cupful of water, together with a teaspoonful of lemon juice. When the syrup begins to boil add two pounds of unroasted shelled peas and cook slowly until the peas are tender and the syrup sufficiently hard to break when quite cold. The cooking process should as a rule continue for about an hour, when the mixture should be poured on a cold buttered platter to cool. Peanut candies are as a rule not adapted to handling in warm weather and should be kept cold after making.

During recent years great quantities of shelled peanuts, especially of the Spanish variety, have been employed for the manufacture of peanut butter. This butter is prepared by the ton in factories, is put up in bottles or tins containing from one-fourth pound to five pounds each, and has become very popular as a part of the luncheon menu and for camping and cruising supplies. In the process of the manufacture of peanut butter the shelled peas are first given a medium roast, care being taken that the meats do not become overdone or scorched. The peas are then fanned and screened to remove the thin brown coverings and the germs, after which they are ground to a pulp by means of a special grinder similar to those used for chopping meats. As the peanut pulp comes from the grinder it is fed through a tin tube into the bottles or tins and tightly sealed. Some manufacturers follow the practice of salting the peanut butter, while others leave this part of the process for the consumer, who can easily salt to suit the taste.

By a little experience and the aid of a small meat grinder, any one can make good peanut butter for home use. The peanuts may be roasted before or after shelling, but in either case the oven should be only moderately hot and the peas should be stirred frequently. After roasting, rub off the skins and screen out the small germs, or hearts. In grinding, use the finest plate on the grinder and screw up the tension until the crank will be quite hard to turn. If the pulp is too coarse after one grinding it may be run through a second time. It will not be necessary to add anything but a little salt to the butter, but if desirable the butter may be thinned by the addition of a little olive oil.

In the preparation of vegetarian meats a portion of the oil is expressed from the ground peanuts, other ingredients, including various vegetable substances, are added, and the whole is crushed and pressed into tins ready for use. In this case the extra oil is either used for thinning peanut butter or sold as a compound for use in further cooking the vegetable meats.

Peanut meal, made from finely ground blanched peanut meats, is used to some extent in confections. This meal is especially desirable in the manufacture of almond macaroons and small cakes, to which it imparts the desired almond flavor. This meal is also used in the manufacture of candies.

Peanut oil is used in the same manner as olive oil; also for mixing with cotton-seed oil in order to improve the quality of the cotton-seed oil for salad purposes.

PEANUT OIL

The oil of the peanut belongs commercially in the same class as do cotton-seed and olive oils. Peanut oil is of a higher grade than cotton-seed oil and of somewhat lower value than first-class olive oil. Peanut oil is sometimes used for mixing with olive oil for the production of an oil that can be sold at a lower price than pure olive oil. On the other hand, peanut oil is frequently mixed with cotton-seed oil in order to improve the quality of the cotton-seed oil for certain purposes.

INSECTS INJURIOUS TO THE PEANUT

The insect enemies of the growing peanut crop have been so few that very little attention has been given them by the entomologists. Recently there has been reported a species of aphis working upon the roots of the peanut plants. This insect belongs to a class that obtains its

food by sucking the juices of the plant from beneath the surface of the leaves, stems or roots. The presence of this root aphis is indicated by patches of what appears to be a white mold upon the roots and pods of the peanut and is generally not observed until digging time. Thus far no great injury from these insects is apparent, but should they become very numerous great damage will ensue, and about the only satisfactory remedy which the writer can suggest is crop rotation, planting peanuts on clean land each year and only returning to the original piece after a period of four or five years.

While in storage peanuts are attacked by various insects. So long as the shells remain unbroken these insects can not gain access to the meats, but where the shells have been injured or broken in thrashing or in subsequent handling the peas can not be kept during the summer months. These insects are especially destructive in storage houses and cleaning factories where peanuts are held for summer trade. They may be destroyed by fumigation with carbon bisulphid in the factory or warehouse. Carbon bisulphid forms an inflammable gas and its use is attended with some danger and should be applied by an experienced person.*

DISEASES OF THE PEANUT

The peanut crop has thus far been remarkably free from disease. About the only disease that has been at all prominent is a form of leaf spot (*Cercospora personata* [B. & C.] E. & E.) which appears in the form of small brown spots on the leaves. (Fig. 9.)

This disease is especially noticeable on the young plants during a wet spring, giving the leaves the appearance of having been scalded by the sun. Later in the season the plants will as a rule outgrow the disease, except in low or poorly drained portions of the fields. Where the disease is abundant upon the foliage the pods are frequently discolored and rusty. There can be no doubt that this disease causes considerable reduction in yield on land that is sour or poorly drained. It is often observed that the disease will be abundant in low spots without spreading to other parts of the field. The presence of the disease upon the foliage of the peanut greatly decreases the value of the vines for hay. Should this trouble become prevalent it may be controlled by spraying with Bordeaux mixture. Its development may be prevented by proper drainage.

Fig. 9 Disease Appearing Upon the Leaves of the Peanut.

CONCLUSION

The peanut is worthy of more general cultivation throughout the Southern states, especially in the boll-weevil district, where it will in many cases be found more profitable than cotton.

The uses of peanuts as a general farm crop throughout the Southern states are becoming more numerous, especially as a

* For information regarding the use of this insecticide the reader is referred to Farmers' Bulletin 145, which may be obtained upon application to the Secretary of Agriculture. No general work has been published by this department on the insect enemies of peanuts, but information in regard to any of them may be obtained by application to the Bureau of Entomology. Correspondence will be facilitated if specimens of the insects concerned in the damage accompany letters of inquiry.

means of providing suitable forage for range stock during the short winter period.

The demand for peanuts to be used in the preparation of human foods is constantly increasing.

The United States is a heavy buyer of peanut oil that is produced abroad, while there are thousands of acres of waste lands in the Southern states that would produce enough peanuts to keep the cotton-seed oil mills running and furnish more than enough oil for home consumption.

The peanut is a soil builder and renovator. If included in the crop rotation and properly handled, peanuts are not exhaustive of soil fertility.

While the average yield of peanuts is only about 34 bushels an acre, with proper methods a yield of 60 bushels of peas and 1 to 1½ tons of forage may reasonably be expected. There are authentic records of yields of 160 bushels of Spanish peas, together with 2 tons of forage, per acre.

The peanut vines, after the removal of the first-class peas, have a feeding value practically equal to the cost of the field culture of the crop. An acre of first-class peanuts, calculating the yield at a ton of vines worth from $8 to $10, and 60 bushels of peas worth $40 to $60, will give an income of from $48 to $70. The cost of growing an acre of peanuts is variously estimated at from $12 to $25, including seed and fertilizers. These figures show a net return of from $36 to $45, which is above the average for the crop as now grown in the United States, but decidedly lower than may be expected under favorable conditions and proper cultural methods.

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Condensed from Farmer's Bulletin 356.

Production of Peanuts in the United States

*This table shows that the production of peanuts is practically confined to the Southern states.

Peanuts—Acreage, Production, and Value

STATE	Acreage		Production (bushels)		Value	
	1909	1899	1909	1899	1909	1899
United States	869,887	516,654	19,415,816	11,964,109	$18,271,929	$7,270,515
Alabama	100,609	78,878	1,573,796	1,021,708	1,490,654	583,223
Arkansas	10,192	5,233	168,608	78,237	183,364	69,632
California	99	433	2,991	15,461	2,889	12,650
Florida	126,150	69,452	2,315,089	967,927	2,146,862	699,713
Georgia	160,317	100,589	2,569,787	1,435,775	2,440,926	935,749
Kansas	48	225	2,047	4,516	2,669	4,306
Louisiana	25,020	3,107	412,037	45,713	422,232	44,785
Mississippi	13,997	5,853	284,791	95,738	317,236	89,350
Missouri	130	271	3,220	6,679	4,040	6,407
New Mexico	126	1	1,375	10	2,177	12
North Carolina	195,134	95,856	5,980,919	3,460,439	5,368,826	1,852,110
Oklahoma	1,564	[1] 2,205	31,880	[1] 50,428	34,984	[1] 30,190
South Carolina	7,596	7,162	154,822	131,710	144,211	106,018
Tennessee	18,952	19,534	547,240	747,668	386,765	392,648
Texas	64,327	10,734	1,074,998	184,860	1,075,110	178,542
Virginia	145,213	116,914	4,284,340	3,713,347	4,239,832	2,261,148
All other states	413	207	7,876	3,893	9,152	4,032

* 1910 Census Abstract.

[1]Includes Indian Territory.

The acreage of peanuts in 1909 was 869,887, representing 0.2 per cent of the total improved farm acreage in the country as a whole. In the South the proportion of the improved farm acreage that was devoted to peanuts was 0.6 per cent. The total acreage of peanuts in the United States in 1909 was 68.4 per cent greater than in 1899, and the production in 1909, 19,416,000 bushels, was 62.3 per cent greater than 10 years before. The value of the crop in 1909, $18,272,000, which formed 0.3 per cent of the total value of all crops, was more than two and

one-half times as great as that in 1899. The average value per bushel increased from $0.61 to $0.94. The leading states in the production of peanuts are North Carolina, Georgia, Virginia, Florida and Alabama, in the order named, the acreage in each of these states in 1909 exceeding 100,000. Other states in which there has been a very marked increase in the acreage of peanuts are Louisiana, Mississippi, and Texas.

PEANUT, SPANISH. See *Apple Orchard Cover Crop.*

Pears

Pyrus communis

The pear is a tree of the order *Rosaceae.* It is believed to be native to Western Asia and Eastern Europe, and from these countries to have been introduced into all the temperate climates of the civilized world. More

An Anjou Pear Tree at Medford, Oregon, Which Has a Remarkable Bearing Record.

pears are grown in France and the United States than in any other countries. In the United States the principal pear-producing sections are New England, New York, Michigan, California, Oregon, Washington and Idaho.

Among the fruits of the United States the pear ranks fourth in commercial importance.

There are two general groups of pears, viz.: the European and the Oriental. The European group originated with *Pyrus communis*, and the Oriental with *Pyrus sinensis*, the native pears of China and Japan. Many varieties of the so-called European pears originated in America as seedlings from the European varieties. Among them are the Seckel Lawrence, Clapp's Favorite, Wilder, Howell and Tyson. However, many of the European varieties came directly from Europe, such as the Anjou, Angouleme, Louise Bonne de Jersey and the Bartlett.

Pears are classified also as Dwarf, Standard and Oriental.

Dwarf Pears

The dwarf pear consists of European varieties propagated on quince roots, the principal stock used for this purpose, being rooted cuttings of a vigorous variety, called the Angiers. The trees so propagated are dwarfed in their habits and bear profusely. In some cases the fruit is improved in quality and in quantity by the dwarfing process. An example of this is the Angouleme. The Seckel is said not to be so good in quality by dwarfing. Natural dwarfs, that is, pears on pear roots, occur occasionally, but generally dwarfing means grafting pears on quince roots.

Standards

Standard pears consist of European varieties propagated on pear roots. The stock for this purpose may be from European seedlings, Oriental seedlings, or almost any kind of rooted pear cuttings.

Orientals

These are of Chinese or Japanese origin. The Orientals are planted in this country not because of their commercial value, for in this they are far inferior to the European varieties, but because of their vigor, hardiness and disease-resisting qualities. Even the hybrids crossed with the European varieties are much hardier than the types of pure European varieties, and under adverse conditions where the European varieties cannot be successfully grown, these varieties are preferable. However, wherever the Bartlett will grow the Oriental varieties should have no consideration. In the South the Oriental pears seem much more resistant to heat and drought than the European varieties, but they are also more resistant to cold.

Location and Soil

Pears may be grown wherever apples can be grown successfully, and are even adapted to a wider range of conditions than apples. They succeed well in the sandy soils of the Southern states whereever peaches do well, in the colder regions of the North and the higher altitudes selected for apples. They are profitable in the arid regions where irrigation is necessary, and on the coast where there is little sunshine and much rain.

In many sections of the West clay soils have been chosen for pears, because on such soils the growth is slower and there is less danger of blight. They are also more resistant than peaches and apples to alkali, which in many places in the arid regions is found in the soil in excessive proportions. It has been proven that pears are more resistant to an excess of water in the soils than other fruits. For this reason it is common to see pear orchards doing fairly well on seepage lands, undrained lands and subirrigated lands, where apples, peaches and other fruits would not succeed.

This does not mean that pears do better on strong alkali soils and where there is an excess of water than they do on soils with less alkali and with better drainage, but that they are more resistant to these unfavorable conditions than are most fruits.

Of late years it has been proven that the Pacific Coast states are especially adapted to pears. Perhaps no other region of the United States will produce

better fruit of this kind than the states of California, Oregon, Washington and Idaho, where immense quantities of the very finest quality are produced. In these states the Bartlett is the leader. Perhaps more Bartletts are grown here than all other varieties combined.

The Bartlett is an early bearer, will begin to bear at the age of three years and from that time forward will bear all that the tree can support. They ripen irregularly and are therefore generally picked at three different times. The first picking takes off the largest, most mature as soon as they are well enough developed for the market, and this lightens the tree so that it will not break under its load. This allows those left on the tree to develop into marketable sizes. The second picking is a week or so later, and takes those next in development and maturity. The third picking is a week or more later than the second and finishes the crop. Some persons pick four times,

Pear Tree 135 Years Old, on the Old Morrison Farm near Cozad, West Virginia.

but the average grower will pick but three times.

The market for the Pacific coast pears is largely in the Eastern cities, but a profitable market is now opening in Europe.

The Bosc is a variety that is rapidly growing into favor on the Pacific coast and in the regions west of the Rocky mountains. It has a very fine flavor and Prof. F. A. Huntley, formerly Washington State Horticulturist, believes that it will take precedence over most other varieties.

Selection of Varieties

In the selection of varieties it is important to consider the climate and the pears adapted to the particular section where the orchard is to be planted. For instance, in Montana, W. R. Fisher thinks that the Flemish Beauty, Bartlett and Clapp's Favorite are the best adapted.

In Wyoming, Prof. Alva Nelson thinks that the Flemish Beauty, Kieffer, Clapp's Favorite, Mongolian Snow and Anjou are best adapted.

In Texas, John S. Kerr thinks the Kieffer is best adapted to all the conditions of arid, semi-arid and humid climates found in that state, as it succeeds well in the "Pan Handle and on the Gulf coast." Next in importance he mentions the Bartlett. In the Reeves county portion of the Toyah valley, the Duchess, Lawren e and Louise Bonne do well. The orchards of Kendall county require irrigation. Here the LeConte, which blights badly in other parts of the state, succeeds well.

In giving the varieties that succeed or that may be grown in Montana, and that may be grown in Texas, we have given such extremes as illustrate the importance of wisely choosing according to conditions.

Granville Lowther

Propagation

Pears are propagated by both budding and grafting, like the apple. The essential differences between grafting pears and apples are: That the pear is always grafted on whole seedling roots, the scion being four to six inches long and the union being made at the crown. Also,

Fig. 1. Pear Grafts Showing Method of Operation.

after the graft is made, the wound must be entirely covered over with grafting wax. As soon as the hot wax is spread on, the graft should be dropped into a tub of water in order to cool it immediately. See Fig. 1.

Seedling pear stock is not extensively grown in this country, owing to the difficulty of securing the seed. Nurserymen import their stock from France, and persons desiring to do their own propagating may purchase seedlings from the nurserymen at reasonable prices. If pear seeds are procurable, it is easy to grow the stock by stratifying them in sand and allowing them to freeze, and otherwise treating them like apple seed. The management of the seedlings and scions and time of doing the grafting, is the same as for the apple. For time, manner and precautions in planting the grafts, the reader is referred to the discussion under apples.

Pear trees may be both budded and top-worked in precisely the same way as that described for apples.

Dwarf Pears

If pear trees are grown upon pear roots, either by budding or grafting, they are known as standards. When worked on the quince root, the pear is easily grown as a dwarf. It then comes into bearing earlier, and since the trees are small, the fruit can be easily thinned and sprayed and therefore should be of a high quality. Dwarfs require more care than the ordinary standards, however, and they should not be planted unless the owner understands this fact and is willing to give the attention that they need. Although the trees are by nature dwarfed, since they are worked on a smaller growing species, they nevertheless tend to become half-standard if left to themselves. A dwarf pear tree should never reach a greater height than 12 feet. In order to keep it down to this stature, it is often necessary to remove from one-half to two-thirds of the annual growth late each winter.

A good dwarf pear tree is one in which the union with the quince stock is very close to the ground. When the tree is planted this union should be from four to six inches below the surface, after the ground has settled. It is the common belief that dwarf pears do not live as long as the standards, but this is not necessarily true. The variety that is oftenest grown as a dwarf is the Duchess. Other varieties propagated as dwarfs are Louise Bonne, Anjou, Clairgeau, Manning Elizabeth, and to a less extent, Bartlett, Seckel and Kieffer. Both standard and dwarf pears are ready to be planted in the orchard after growing in the nursery for one or two seasons, the two-year olds being preferred.

See article on *Propagation*, under *Apples.*

W. L. Howard,
Columbia, Mo.

Planning the Pear Orchard

In no phase of pear culture is the skill and experience of the orchardist more thoroughly brought to the test than in the preparation of the plans for the orchard. He must not only decide upon the varieties and the relative importance of each, and the distance apart of the trees, but must also consider the relative time of ripening of the fruit, so that it can be marketed with reasonable convenience with the facilities at hand; and he must also bear in mind questions of pollination, so as to have mutually fertile varieties, which bloom at the same time, planted near together.

In all cases, when planting out an orchard of an acre or more in extent, it is best to make a preliminary survey of the ground, and then draw up a preliminary plan on paper. This need not necessarily be a plat, but should show the number of rows and the number of trees of each variety in each row. Dwarf pears are ordinarily planted at distances between 8 and 16 feet apart each way, standard pears about 20 feet apart, and Oriental pears about 30 feet apart. In the writer's own orchards the trees have been planted on a rectangular system, that is, instead of planting the trees 20 feet apart and in rows the same distance apart, in squares, they have been planted 16 feet part in rows 24 feet apart. The reason

Fall Sweet Duchess Rutter Seedless

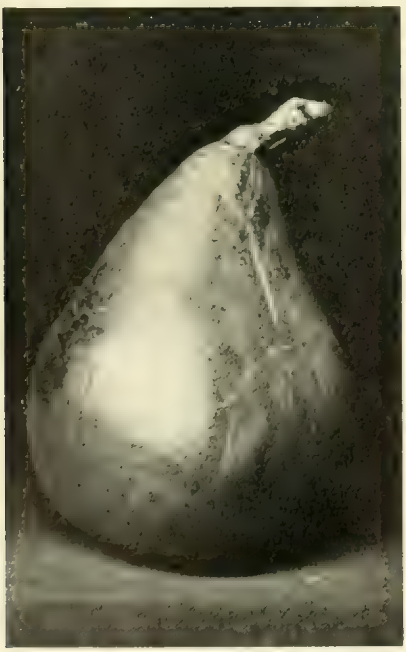
for this is that in planting, fillers have been generally used, that is, temporary trees have been set out between those which were to remain permanently. By planting out the orchard, for example, with standard pears at intervals of 12 by 16 feet every other row of the 12-foot rows is a filler row. As the trees begin to crowd, these are taken out, and the trees are left 16 by 24 feet apart. In either case the rectangle approaches so nearly a square that it is perfectly convenient to carry on the operations of cultivating, spraying, etc.; in fact, it is more practicable to have the trees farther apart one way than the other, as this leaves a broader strip for plowing and more room for spraying and hauling out the fruit as the trees begin to fill the space completely. For dwarfs the distance of 12 by 16 feet was adopted, with a filler row between 16-foot rows, which makes the trees stand 12 by 8 feet. The distance for the standard pears is 16 by 24 feet, with fillers between the 24-foot permanent rows, the trees thus standing in the original planting 16 by 12 feet apart. In the Oriental orchard the distance is 24 by 32 feet, with a filler row between the 32-foot rows, making the trees stand 16 by 24 feet apart. It will be noted that each of the two latter distances is double that of the preceding, so that the orchards can be planted adjoining and the rows be continuous, which is a great advantage in plowing and cultivating. Furthermore, all the distances are multiples of 4, and this arrangement gives the convenient distance of 4 feet for planting truck crops, cow peas, etc., in the young orchard.

Preparation of the Soil

The pear, like most other fruit trees, is very susceptible to previous preparation of the soil. As a rule, it is best, if possible, to plan beforehand where the orchard is to be located, and begin the preparation of the soil one or two years before the trees are planted. A well-cultivated crop of Irish potatoes, or any of the hoed garden truck crops which require high manuring and thorough cultivation, may be considered as good preparation for the pear orchard. The soil, unless naturally very deep, should be plowed an inch or two deeper each year for a year or two in anticipation of planting out the orchard. In this way the soil will be materially deepened and enriched and its mechanical state improved.

These remarks apply more especially to dwarf-pear culture, but also have a considerable bearing on the behavior of Orientals and standards. The principal advantage in thorough preparation is the

saving of time. The young trees start off more rapidly if the soil is previously thoroughly prepared. Orientals and Bartletts may be planted on newly cleared land when no other is available, but, as a rule, the land should be planted to a crop for at least a year or two before setting out the trees. Most soils suitable for pear culture have a more or less stiff clayey subsoil. It is a great advantage to thoroughly loosen this subsoil by plowing or subsoiling before setting out the trees. If the orchard is planted in the fall of the year, which is the preferable time in the Eastern and Southern states, the land may be subsoiled by following with a subsoil plow immediately after the turning plow. It is not necessary, however, to subsoil the whole area of the orchard unless this is desired for the cultivation of other crops among the trees. The land may be plowed first, and then a special preparation of plowing and subsoiling may be given to a strip about 6 feet wide on which the tree row is planted. This may be widened by subsoiling a strip around the trees each year ahead of the spreading roots until the middle is reached. Of course, very good preparation in many parts of the country for meadow or pasture land would consist in plowing it up rather early in the fall, then harrowing a strip on which the trees are to be planted. More orchards have been planted without subsoiling than with it.



Krull x

How to Plant Out the Orchard

Each orchardist will no doubt develop some method of his own in planting out the orchard. There are many methods, however, of undertaking the work by which time is saved and accuracy secured. One of the simplest ways of planting out an orchard, and a very good one under certain circumstances, is to measure off the land with a tapeline or pole, driving a small stake at the end of each row around the orchard, and then with a one-horse plow, or other convenient implement, check off the field into squares. The trees are then planted at the intersections of the furrows made by the plow. On level land, with a skilled man to run the furrows, quite accurate results may be obtained by this method. As a rule, however, the writer has found another method preferable, namely, planting by stakes. The method by furrows is objectionable for two reasons: (1) In order to save digging the holes it was found desirable to plow out a deep dead furrow with a two-horse plow, making from three to five trips, and when this large dead furrow was thrown out it was impossible to use it as a planting guide with any accuracy; (2) difficulty was encountered in securing accurately laid-off furrows, especially on rough land or land where any sort of obstacles intervened.

The method of planting by stakes starts out essentially the same as the above method, by setting pegs and laying off with the plow. The pegs should be put a rod or two outside of the outer row of trees and parallel to it all around the block. These pegs may be quite small, split from a block of wood, and should be set accurately. A quantity of stakes should be made 4 to 6 feet long. The head man takes an armful of stakes, and beginning at the peg back of tree No. 1

drives a stake accurately behind it. At the same time an assistant, stationed at the opposite side of the field, also carrying an armful of stakes, places a stake at his end of the row. A third man with a supply of stakes is stationed midway between these two, and after the end stakes are driven the foreman sights between them and accurately locates the position of the middle stake while the helper drives it, thus setting the three stakes in line on each row. In the same manner the rows are staked out in the other direction. This is very quickly and accurately done unless hills are encountered, which are difficult to sight over, but by using a long pole for guiding the location of the stakes this difficulty may be overcome. The result is a stake marking each end of each row and a row of stakes across the center of the field each way marking the middle point of each tree row.

Taking the most convenient direction, the deep dead furrows are then plowed, and necessarily with them the center stakes, which must be reset by sighting. The trees are then brought into the field and the bunch of bundles required to plant each particular row, as shown by the plan on paper, is then roughly heeled in in the dead furrow at the end of the row. While up to this time considerable labor has been expended in preparation work, from now on the planting can proceed with great rapidity and accuracy. The planting gang should consist of four men, viz., the foreman, who holds the tree and tramples the earth around it; two shovelers, one of whom must be a good hand at sighting a straight row; and a fourth man, who prunes and drops the trees at about the places where they are to be planted. The foreman holds the tree in his hands in a vertical position and sights accurately its alignment with the center stake and the end stake beyond. The first shoveler stands in line with the cross row and sights on the center stake and end stake of that row. This results in easily placing a tree within an inch of where it should be. If any additional digging is necessary the two shovelers strike in with their shovels and remove the necessary earth. The tree is then set in place, and the mellow earth shoveled around it, the foreman trampling the soil firmly around the roots as it is thrown in. He keeps the tree in line on the row being planted, while one of the shovelers sees that it is kept in line in the other direction. In this way four good men can plant out easily from 500 to 1,000 trees in a day. When the planting is finished, a one-horse plow is used to fill in the dead furrows and to throw the earth more thoroughly around the trees.

Vicar of Wakefield.

Cultivation

The history of the pear orchard in all questions of cultivation should be considered as divided into two periods: (1) the young orchard before it comes into bearing, (2) the bearing orchard. It is necessary for complete success in growing pears that the ground should be thoroughly plowed each spring and kept in a good state of cultivation until midsummer. In the young orchard this involves a great deal of expense with very little

apparent return unless some other crop is grown in the orchard. By growing the right kind of crop, especially one which requires high fertilization, instead of drawing from the soil and impoverishing it, the result is the enriching of the soil; in other words, the crop becomes a veritable nurse crop. The only disadvantage comes in a dry season when there is not enough water in the soil for both the trees and the crop, even though ample plant food may have been artificially supplied. The nurse crop also frequently prevents the thorough midsummer cultivation, which is so necessary in a dry season.

Of the truck crops grown in the pear orchard, almost any of the low-growing garden crops may be cultivated, such as cantaloupes, sweet potatoes, Irish potatoes, and cucumbers, as well as cabbages, beans, peas, beets, turnips, etc. Crops which have to be dug late in the season with a plow or other implement, such as Irish potatoes and sweet potatoes, are probably less desirable than such crops as cabbages, peas, beans, and similar crops. During the first two or three years the truck crops can be planted in the first row 4 feet from the row of trees, and the tree row should receive the same cultivation or even more than the truck crop. After the third year, when the roots of the trees have begun to spread out through the soil and the tops cast a larger shade, the truck crops should not be planted quite so close. At five years of age it is usually best to abandon the outside row entirely, leaving a space of 8 feet. Most pear trees at six years of age begin to bear heavily and need all available soil moisture and plant food. Corn may be grown in the richer soils for the first year or two; but on the whole, any plant of as rank growth as Indian corn can not be considered a desirable crop. Wheat, rye, or cereals, which do not allow cultivation during the spring and early summer, are decidedly objectionable. Unless the soil in the pear orchard is overrich, which is not apt to be the case, it should always be the rule to apply more fertilizer to the nurse crop than the crop itself removes. The crops should not be planted within 4 feet of the trees. This practice of growing other crops in the orchard is often condemned by writers and fruit growers on theoretical grounds, but in a practical way, if the above conditions are properly complied with, there are no serious objections to it. The young trees themselves require some fertilizer, but this will be considered later. By skillful management, the growing of vegetables or other crops in the young orchard for four or five years preceding bearing may be made to pay the cost of the improvement of the soil. The cultivation of young trees themselves is not very different from the cultivation of any other tender plant, and, as everybody is familiar with corn culture, we may lay down this rule: Cultivate the pear tree just as you would a hill of corn if you were trying to grow a specially fine hill of corn. Great care must be used to keep from injuring the trees. Hired help who have not had experience in cultivating trees, even though they have had experience in cultivating corn and other crops, are not apt to realize the injury that a touch of the singletree or parts of the harness may inflict on the tree. When growth starts in the spring, the young trees, if struck in this way, are likely to be very seriously damaged. To avoid this, a careful and experienced man should be employed to plow the first furrow around the trees. The singletree should be extremely short, as short as possible for the horse to conveniently work in. Unless some special device is used for fastening the tug at the end of the singletree, it should be protected by wrapping a piece of old sacking around it, so that in case a tree is struck it may not be seriously injured. Even with the utmost care, however, the young shoots are frequently broken off, when they are from 3 to 6 inches in length, by a mere touch.

In the plowing of the ground in the spring for the young orchard, it must be borne in mind that the dwarf pears do not thrive as well if the earth is plowed away from them as when back-furrowed around

them. The quince root is of such a character that it prefers the excess of moisture, and the latter method serves to retain moisture, while the former has a somewhat drying effect. It is therefore usually best in the dwarf-pear orchard to continue plowing year after year toward the trees, and depend upon the cultivation and cross-harrowing to level the land again. If the tendency to ridge becomes too pronounced, it may be obviated by plowing two or three furrows toward the tree row, and then back-furrowing in the middle of the strip, leaving two small dead furrows near the tree rows instead of one in the middle. These small dead furrows will be more easily filled by the cross-harrowing. In the case of standards and Orientals, if the soil becomes ridged, it will do no harm to plow away from the trees to the level land.

One point should always be borne in mind in the cultivation of the pear orchard as compared with that of peaches, apples, and other fruits; this is, that the pear tree makes its growth very early in the season. Most of the annual twig growth on the trees, at least after the age of three years, is made within four to six weeks of the blooming time, and very little of it is made during mid-season and thereafter. Special attention, therefore, should be paid to the early cultivation of the pear orchard. Later in the season cover crops may be grown, or, if comparatively free from weeds, the orchard may be allowed to take care of itself. In case of young trees, plowing should usually be finished before the buds have swelled sufficiently to be easily injured by the horse when brushing past them. When the buds are dormant the injury is very slight; if, however, the buds are an inch or so long, many of them may be brushed off. It is often wise to plow the first two or three furrows with the one-horse plow while the trees are dormant, and then later, even though the buds may have pushed out, to finish the plowing in the middles with the two-horse plow. The cultivator should, if possible, follow the plow just before the buds have pushed out appreciably. The one-horse five-tooth cultivator is suitable for this purpose. This will mellow the ground and put it in a finely pulverized condition, which at that season of the year will enable it to retain its moisture for a fortnight or more. If possible, the trees should be allowed to bloom and to start their twig growth before the cultivator, with its accompanying danger to the buds, is again used. By cultivating the trees on a dry day, when the foliage and twigs are somewhat limp, the minimum amount of injury will be done. At least four or five cultivations at intervals of about ten days to two weeks should be given to the young pear orchard. In the meantime the other crops planted between the trees may require cultivation, but the cultivation of the pear orchard should proceed independently in case these crops are not ready for it.

In the bearing orchard the plowing in spring is, of course, the same, but the absence of other crops between the trees renders the cultivation much simpler and more economical. Having plowed the orchard, the cultivator, spring-tooth harrow, or some other form of harrow should be passed over at such a time that it will be most effective. The land can then be left until after the trees have bloomed, when a second harrowing, preferably in the opposite direction from the first, should be given. The ground should then be harrowed over about once in ten days, five or six times, keeping the soil in a finely pulverized state. If heavy rains occur, pounding the ground and compacting the surface, the crust which forms on drying out should be promptly broken before the soil becomes too hard.

It will hardly be possible to mention the many implements useful in the cultivation of the pear orchard. The disk harrow, the cut-away harrow, and the spading harrow are very useful types, and in certain conditions of the soil are very effective. The spring-tooth, the ordinary spike-tooth, the Acme, and even the weeder, are very good implements. The weeder, however, is not as desirable in the pear orchard as it is among peach trees, for the reason that the pear is

deep-rooted, and can better withstand and profit by deep cultivation than the peach. As to the depth of plowing, the writer is inclined to favor rather deep plowing for the pear orchard. If the trees are set with the point at which they were budded two inches below the surface the first two or three furrows may be made about as deeply as a one-horse plow can go, namely, 4 to 5 inches. After the third furrow the two-horse plow can be used, and as a rule the land should be plowed as deeply as it will stand; in other words, as deeply as the soil will permit without turning up too much of the clay subsoil. It is usually wise, unless great care has been taken in previous preparation, to plow the middles of the pear orchard very deeply, turning an inch of subsoil to the surface each time. In this way the soil will be deepened; 8 to 10 inches is none

Seckel Pear.

too deep and less than 6 inches should not be considered deep enough. As the trees spread out and the root systems occupy the soil, the plowing may be an inch or two shallower than in the young orchard, but with this exception the depth should always be maintained. It is a great mistake to plow the orchard shallow for a number of years and then plow it deeply, for many of the roots will have developed at shallow depths, and the subsequent deep plowing will tear up and destroy them.

Fertilization

Few soils really adapted to pear culture are fertile enough to support the bearing pear orchard without some assistance in the way of manures and fertilizers. If the soil is tolerably fertile, that is, capable of growing 40 bushels of corn per acre, the young orchard may need no assistance whatever until it has borne a heavy crop, after which, as a rule, some additional plant food will be desirable, if not absolutely necessary. As above suggested, however, young trees usually need to be fertilized individually during the first two to four years after planting out. For this purpose any good, complete fertilizer may be used, one containing 10 per cent of potash from muriate of potash, 7 to 8 per cent of phosphoric acid from acid phosphate or dissolved bone, and 4 per cent of nitrogen (half from nitrate of soda or dried blood and half from tankage, bone, or some other slowly available form or organic nitrogen). Before the trees have pushed out into growth the first spring after planting, a large handful (about one-third of a pound) should be thrown immediately around the tree and hoed or cultivated into the soil. When the tree begins to absorb soil water and push out its new leaves, it will at once feel the stimulus of this fertilizer, and as a result the leaves will come out large and of a dark-green color, and the twig growth will be robust and vigorous even though the trees are on poor ground.

The second year it is best to put the fertilizer in the bottom of the furrow after the first trip with the plow has been made on each side of the tree row. A handful of fertilizer should be strewn in each furrow for a distance of three or four feet each way from the tree. The second furrow is then plowed, the dirt being thrown on top of the fertilizer. If stable manure is to be applied, it may be put in the bottom of the furrow and covered up in the same way. It is a good plan to fertilize all the trees the second year with about one pound of commercial fertilizer to each tree, and then to give a special manuring with two to four shovelfuls of good stable manure to the weak

trees and those growing in the poorest soil. If it is desired to continue fertilizing the trees individually during the third and fourth years, it may be done in the manner described, but the fertilizer may be placed in the second or third furrow from the tree instead of the first one. In succeeding applications it is better to fertilize the whole area of the ground rather than the individual tree, especially in the case of standards and Orientals.

In the fertilization of the orchard some general system of building up the soil as a whole should be adopted, and the three following methods are worthy of consideration:

The first method, which has already been discussed under "Cultivation," consists in applying fertilizers to truck crops grown as nurse crops in the orchard. The residual effect of the stable manure and fertilizers applied to the nurse crops is very beneficial to the soil and, therefore, to the trees in the orchard.

The second method consists in the use of green manures and the mineral fertilizers, potash and phosphoric acid. A very good proportion is three parts of acid phosphate and one part of muriate of potash. This mixture is applied at the rate of 400 to 800 pounds per acre, and will supply all of these ingredients necessary for large crops. The green manures, that is, crimson clover, cow peas, etc., are depended on to furnish the nitrogen and the necessary organic matter to keep the soil in a high state of fertility. In the pear orchard the problem of growing the green manures is not a difficult one, for the reason that the tree-growth is made early in the season and the long growing period from midsummer to autumn is available for growing leguminous crops. If crimson clover is grown, it should be plowed under rather early in the spring to get the best results.

The third method, the simplest of all, consists in the direct feeding of the trees and the soil with fertilizers and manure. If the trees do not respond in a satisfactory manner to good cultivation and pruning, that is, if they do not throw out from 12 inches of growth on the dwarfs to 3 feet on the Orientals; and if they show the ordinary symptoms of starvation, that is, small fruit and small foliage, plant food should be applied to them until they grow out of this condition. In this respect the dwarf pear is much more exacting than either the ordinary standards or the Orientals. It requires high manuring and fertilizing, and the fertilizers must be applied very close to the tree, as the quince roots do not spread out like those of the pear.

Many old-fashioned fruit growers prefer to use wood ashes, stable manure, and ground bone for the fertilization of dwarf and other pear trees, and there is no question that these materials are very desirable, if not the best to use. As a rule, however, potash can be bought much cheaper in the form of muriate, and phosphoric acid cheaper in the form of acid phosphate, so that it is more economical to purchase these forms, and they are probably just as good.

It is an excellent practice to fertilize the bearing dwarf-pear orchard in the manner above described for the young orchard. Three to six large forkfuls of stable manure may be applied in the furrow in the spring or thrown around the trees in winter, and from one to five pounds of complete fertilizer of the formula suggested should be applied early in spring and cultivated or harrowed into the soil. Standards and Orientals will of course respond to good fertilization and cultivation, but as their root system is very widespread and deep, they do not feel the necessity of additional plant food as keenly as dwarfs, and do not respond to its application so readily.

In the use of potash and phosphatic fertilizers there is little danger of injury from an excessive amount, but nitrogenous fertilizers must be used with great care. Stable manure should be applied only in early spring, never in midsummer, and a light dressing, not to exceed six large forkfuls, is the maximum amount that may be used safely on each young tree, although trees bearing heavily will stand more. Care must also be exercised in the use of nitrate of soda, cotton-seed

meal, blood, tankage, and other nitrogenous fertilizers, as it is rarely safe to apply more than 200 pounds per acre of any one of these materials. Bone, bone tankage, or other slow-acting and insoluble nitrogenous substances may be applied in the fall and winter if preferred and in larger amounts. To avoid waste, nitrate of soda and other soluble forms should not be applied until about the time growth starts. The danger in applying nitrogenous fertilizers and stable manure in excessive amounts or late in the season arises from the fact that the trees are stimulated to make a late and immature growth of the cambium and twigs, and are thus rendered susceptible to injury from winter-killing and pear blight.

The methods of fertilizing above described are intended to push the pear tree into as vigorous growth as possible and cause it to bear the largest possible crops of the best-developed fruits. It is well known to most growers, however, that pear trees forced with stable manure and fertilizers and by good cultivation become very susceptible to blight, and when attacked are most severely injured by it. As a result of this, growers are continually restrained in their efforts in fertilizing their pear orchards, and generally aim to keep their trees in a semi-starved condition. As to the wisdom of this policy, we are not prepared to decide definitely, and each grower must be left to decide the matter for himself; but it may be said that while a moderate restraint in the fertilization may be considered proper as a rule, it is better to take some risk at least, so that if crops are produced the fruit will be of such quantity and quality as to be profitable.

Pruning

There is no branch of pear culture more commonly neglected by the average commercial orchardist than that of pruning, though the subject has received very careful attention from certain men. In foreign countries, especially in France and Belgium, great attention is given to the details of pruning. Great labor is often expended on the trees in the nursery and in the orchard in developing them into geometrical forms. While the extreme conventional forms of trees may properly be looked upon by American commercial orchardists as a waste of time and money, yet the theory is correct. There are practical reasons for pruning bearing fruit trees to certain ideal types. For the American orchardist there are three main types of pear trees to be considered—the pyramidal form, the vase form, and the natural form. Largely through the efforts of Patrick Barry, Marshall P. Wilder, and other leaders in American pomology of the last generation, the pyramidal form of pear tree has been considered as the proper ideal, and is in fact the almost exclusive form for American orchards. In the opinion of the writer, however, the pyramidal form has been advocated to an extent far greater than it deserves. The vase-form tree, while somewhat more difficult of development and somewhat less natural, is in many ways far superior to the pyramidal form. The natural form finds its principal advocates among those who know little or care little about pruning, and seem to find consolation in falling back on the theory that nature knows better than man what is best for the tree. They overlook the fact that the fruit tree is an entirely artificial product and is under artificial conditions. Were the theory that nature knows best to be consistently followed, we should only plant the seeds of fruit trees, never bud nor graft them, nor cultivate, spray, nor carry on any of the other horticultural operations on which the success of fruit raising depends.

There are arguments pro and con in favor of each of these three forms. The pyramidal form of tree is with most varieties more natural than the vase form. It permits heavy cutting back and thinning out without interfering with the general scheme of pruning. This form is so nearly that of the natural tendency of most fruit trees, especially while they are young, that it requires little effort to balance or curb undesirable tendencies. It has the disadvantage of not being adapted to such extremely low heading as the vase form, of having a large portion of

its fruit more difficult of access, and, in case of pear blight, the branches are so arranged that the life of the tree is more quickly imperiled by the disease.

The vase form of tree has the disadvantage of requiring considerable skill during the first few years of pruning. It is somewhat unnatural to most varieties of pears while they are young, and it therefore requires considerable effort to keep the tree properly balanced and to develop successfully the desired form. It has the advantage of being the easiest tree to work around, the easiest for thinning and picking the fruit, and to prune after the first few years. It is also the most convenient tree to spray, and is a thoroughly satisfactory form from the standpoint of fruitfulness. In pear orchards, however, one factor alone should be sufficient to lead to the adoption of this style of pruning, namely, the much greater ease with which pear blight can be fought and pruned out. The low-headed vase form of tree, with the body 16 to 18 inches high and the limbs and main branches cut back so that they fork at about 12 to 18 inches, and with the main limbs kept entirely free from fruit spurs and fruit-bearing branches, is by all odds the safest form of the three to withstand blight.

The natural form of pear tree involves very little pruning, merely sufficient to clear out the interlocking branches and to remove water sprouts and an undesirable surplus of limbs at any point. It is the cheapest because it requires the least work. However, when such trees come into bearing they usually overbear certain years. With many varieties of pears, the Kieffer, for instance, the trees are likely to break down with their load of fruit, and require several years to recover. The saving of expense in pruning by no means compensates for the loss.

The Vase Form

In order to secure the vase form of tree, which the writer advocates, the nursery tree when planted in the orchard should be pruned to a straight cane about 18 inches high. The Garber and some other very spreading types may possibly stand two feet in height. On the other hand, very upright growers like the Kieffer, the Bartlett, and, as a rule, most of the dwarf types, should be pruned to from 12 to 18 inches. This straight stock, if properly planted out, will throw out a number of shoots the first year. When the buds have pushed out an inch or so they should be rubbed off the lower half. When the new growth is about 6 to 10 inches long the trees should be visited and three branches selected for the future main limbs. These three branches should be arranged in a circle so as to form an inverted tripod, and should not radiate from one point, whatever the type of tree adopted, but should be several inches apart vertically. Having selected these three main twigs, all the other growth should be pinched off at the tip, allowing these shoots to become strong, vigorous twigs; and in a good tree they may reach a length of three to six feet the first year. If any one of these shoots shows a tendency to outgrow the others, it may be pinched back when 10 inches or so long, in order to retard it until the others catch up. In the winter, or preferably just before the buds swell in the spring, the three shoots which have been selected for the main limbs may be headed back, preferably leaving a branch from 12 to 18 inches long, making the inverted tripod level across the top. A length of 12 inches is best for dwarfs, while a greater length is more suitable for standards and Orientals. All other twig growth is removed. The following spring, when the buds are pushing out, all of them starting on the trunk and main limbs, except on the upper six inches, should be carefully removed by rubbing with the hand, protected with gloves if necessary. When the new growth has pushed out 8 or 10 inches it is often desirable to go over the trees again, removing or pinching back any undesirable sprouts. For the next winter's pruning two of the most desirable twigs on the upper part of each of the three arms of the tripod which extend upward and outward should be selected and cut off to 12 to 18 inches, and the other branches of the tree should be again removed. The

third year this operation is repeated, leaving a pair of outwardly diverging twigs, extending upward on each shoot of the previous year. By the third pruning it will be wise to begin to leave certain small twigs which extend laterally or downward as temporary fruiting branches. These twigs should be such as not to interfere with the strong-growing upright branches, which are intended to form the main framework of the tree. At this stage of the development the principal attention is devoted to this main framework of branches. Every twig which is left in the tree is carefully considered as a future branch. These temporary fruiting branches form the only exception to this rule. The fourth and fifth years' pruning should be continued on the same line, but more attention should be paid

Bartlett Tree

to leaving fruiting branches. As the top of the tree develops, after the fifth year, of course very many fruiting branches will be formed, and later on all such branches which have been left on the first five years' growth should be cut away entirely; but in order to avoid the loss of fruit during the earlier bearing years these branches may be allowed to form temporarily and to bear several crops of fruit, and may be disposed of when they can be spared. After the fifth year it is rarely possible to continue the ideal form as far as each individual twig is concerned. The general shape and style of the tree is determined entirely by the previous pruning. Efforts should be directed simply to keeping the tree in the form already attained.

The pruning must vary considerably with the variety of the tree, and is naturally different in case of dwarfs, standards, and Orientals. The dwarf pear, with its usual tendency to overbearing, should be continually headed back to about 8 to 10 inches of annual growth. If an excessive number of fruit spurs develop on top of the tree at the expense of vegetative shoots, the vegetative tendency of the tree may be promoted by cutting back even into 3-year or 4-year-old wood. This will remove some of the surplus top and cause the tree to throw out strong, vigorous sprouts, which may be headed the next year. In heading back old wood on bearing trees, if possible the branch should be cut off where a new young sprout or branch extends outward, as by so doing the new branch will take the place of the old one, and will receive the tremendous stimulus caused by the concentration of the sap into the smaller twig. In this way a continual renewal of the bearing wood can be kept up. In the case of standard trees, if the main twig growth exceeds a length of 18 inches it is usually best to head back everything above that length. In this way long, slender, drooping branches can be avoided and the branches made stocky and strong and capable of bearing a very large load of fruit. Trees like the Kieffer, if allowed their own way, develop fruit spurs in abundance. These form on the ends of long branches as well as in the body of the trees, and in a favorable season the tree loads itself down with fruit. The result is disastrous, for the slender branches are unable to support the tremendous load, and break off within about a foot of the trunk. The heading back will entirely prevent this destruction and tend to keep the tree in continuous bearing.

The Pyramidal Form

The pyramidal form is a much simpler and easier form in which to train most varieties of pears, because it conforms essentially to the natural tendency of the trees. It is usually best to head the trees to a straight cane in planting them out, as previously described, though this is not necessary if the head has been formed in the nursery at the point desired by the orchardist. This is very rarely the case, however, as most nursery trees are headed too high. If the tree is headed at the proper height in the nursery, it will simply be necessary to cut the leader back to about six inches and to trim three or four of the secondary branches to about three inches. The tree may then be allowed to go during the season with very little pruning. It may be necessary to go over the trees after six or eight inches of growth has been made and pinch off an occasional shoot which has not developed in conformity with the pyramidal form. Sometimes two leaders will form nearly equal in size. One of these should be pinched back and the other allowed to remain.

In the winter pruning the central leader is first selected and cut back to the height at which the next whorl of limbs is desired. In the dwarf pear this should be about 12 inches; in Bartletts and other standards about 14 to 16 inches; in strong-growing Orientals, like the Kieffer and Le Conte, 18 to 20 or even 24 inches may be proper. The lower whorl of main limbs is then examined and about three or four branches are selected. These are cut back to a length of about 12 to 18 inches, or about two-thirds the length of the leader. All other branches or twigs interfering

with this main framework are then removed. In the next year's pruning, at the conclusion of two years' growth, the central leader is again selected and cut off at the same length as in the previous year; the 1-year-old whorl of branches at its base is examined and pruned in about the same manner as the previous year, leaving three or four twigs to form main limbs, and the lower whorl, which now has two years' growth on each branch, is treated in much the same way that the pyramidal top has been treated, namely, the leader for each branch is selected and headed back, leaving it about two-thirds as long as the leader at the top of the tree. At the base of the leader on the two-year wood about two or three secondary branches are selected and headed back, so as to subordinate them to the leader, and the other twigs on these branches are cut off. All of these main branches are selected with reference to their forming the framework of the tree exactly as described in pruning for the vase form of tree. Temporary fruiting branches may be left in the same manner also as described in that form. Water sprouts and limbs in undesirable places are of course removed.

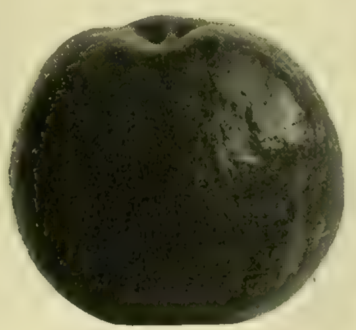
The third-year pruning of the pyramidal form proceeds on the same lines, the upper part of the tree being pruned exactly as in the previous years, the only addition being that one more joint is added to each main branch and one more set of lateral branches has to receive attention each year. The pyramidal form of tree does not change, and the general plan of pruning continues the same through its entire life. The only thing to avoid in this type of tree is the tendency to become too thick and bushy in the repeated heading back which it receives. To avoid this the pruner should be prepared to thin out unnecessary branches as well as to cut back. Fruit spurs will begin to form on the branches after the third year. These may be left temporarily and afterwards cut away. It is undesirable even in the temporary form to allow young branches to become thickly grown with lateral fruit spurs, for the reason that such spurs are not nearly so well nourished as those on smaller branches carrying vegetative shoots, and furthermore such branches are a great deal more liable to destruction by pear blight. These numerous lateral fruit spurs when in bloom afford many opportunities for blossom-blight infection, and when such a branch is attacked by blossom blight the disease has only a very short distance to run from the fruit spur into the main limb, which it can girdle with a minimum amout of diffusion.

The Natural Form

In each of the other two forms of fruit trees the aim is to curb the tendency of the trees and their individualities. The tree is made to conform to the ideal in the mind of the pruner. If too many upright branches are thrown out they are headed back and made to sprout laterally; but, on the other hand, if the tree has a spreading or drooping tendency the lower branches are pruned off and the more upright ones are encouraged. In this way all varieties are made to grow as nearly alike as possible. It is by no means entirely possible, however, to entirely curb the natural tendencies, and it can be done only approximately. The natural form, on the other hand, allows the tree to develop its own individuality. But some pruning is absolutely necessary, even if the idea of the natural form is to be carried out. In planting out, the branches may at least be headed back to spurs three or four inches long. As far as pruning is concerned, the trees may then be practically neglected for the first two or three years, but it is better to look them over every year and remove water sprouts and any branches which interlace and chafe and to examine for any wounds which should receive attention. Trees of this sort will come into fruiting earlier than those headed back and manipulated into an ideal form, for the reason that the vegetative tendency is not encouraged at all. As soon as the reproductive tendency develops it is allowed unrestricted course. However, the difficulties of reaching the fruit in the case of tall pyramidal trees, the tendency to break

down in the Kieffer and a great many other varieties, and above all the danger of pear blight of this form of tree, make it undesirable in actual practice. Even in case of the natural form, where very little pruning is intended to be done, the writer advocates low heading. The trunk of the fruit tree has lost its function. It is an unnecessary and expensive thing for the tree to construct. It renders the tree more liable to disease, and by elevating the top from the ground increases the danger of its being blown over and of the fruit being blown off. Every inch of additional height increases the expense of pruning, spraying, and especially of picking. The trunk of a forest tree forms a very conspicuous part of the tree itself, situated in the open field grow a very short trunk. Oftentimes enormous oaks, with a spread of perhaps 100 feet, have only a few feet of trunk. Orchard trees, which are not only planted in open ground, but are also given proper spacing and cultivation, are entirely removed from the struggle for existence which competition and crowding brings about. The trunk of the pear tree, therefore, may be looked upon as entirely superfluous. In a fruit tree, the part that does the work is the top. In other words, in pear trees we should seek to develop the top as much as possible. The tree carrying the greatest amount of foliage and the greatest number of properly placed fruit-bearing branches is the ideal tree.

Big Romanite.



Idaho.

Both are very large pears.

and in the struggle for existence, especially among young trees in the forest, the tall-growing trunk is an absolute necessity to the species. The effort on the part of each individual tree of the forest is to rear its top up to those of its neighbors. The struggle for light and air causes the tree to develop its trunk, which becomes very useful to man in many ways. The trunk of a forest tree, therefore, has gained our respect through its usefulness and beauty. On the other hand, even the native forest trees when

Thinning the Fruit

No discussion of pear culture would be complete without including this important operation, and as it belongs on theoretical grounds with pruning, we may consider it here. It is a great mistake to allow pear trees to overbear. When the fruit is about an inch in diameter the trees should be gone over carefully and all the surplus pears, over and above what the tree can mature properly, picked off. Each branch should be examined, and, with the size of the ma-

ture fruit in mind, the number reduced to the proper amount for that size of branch. All imperfect, wormy or distorted specimens should of course be picked off first, and only those which are expected to make fancy fruit left behind. Unfortunately, no general rule can be given to guide in thinning pears. The rule of one fruit to six inches, which commonly guides the peach grower in thinning peaches, can not be definitely applied to pears. Experience is the only guide, and the grower may expect to allow a few trees to overbear before he learns the lesson of just how much to thin. Thinning not only improves the quality of the fruit of the current season, but it places the tree in better shape to bear the next year. As a rule, greater profits are secured by regular annual crops than by heavy crops during occasional years, for it commonly happens that such seasons are the very ones when fruit is plentiful and cheap and the profit in handling it very small.

M. B. WAITE, Assistant Chief,
Division of Vegetable Physiology and Pathology, Washington, D. C.

Pruning Dwarf Pears

Dwarf pears are as a rule pruned as pyramids. For this reason the nursery trees are handled very differently from standards. Branches are allowed to grow close to the ground and a central axis clothed with branches from near the ground to its extremity is maintained rather than a bare trunk to the height at which the head is desired, as in the standard tree. In the pyramid these lateral branches are left longest near the ground and shortest near the apex of the pyramid. This method is adhered to from year to year in pruning the annual growth of the tree. The annual pruning of a pyramid is of even greater importance than in the case of the standard pear, for upon it depends the symmetrical development of the tree.

It is well known that orchard trees in general tend to make their greatest growth near the extremity of the leading branches. In other words, the leaders are the strongest growers and it is frequently a difficult task to stimulate lateral branches to grow sufficiently to preserve a symmetrical development in the tree. The manner, therefore, of cutting back the annual growth on the various parts of the tree must be carefully studied in order to preserve the symmetrical development desired. In removing the annual growth from pyramidal trees it should be the aim to cut back to an inside bud each year. This will tend to make the growth of the tree more upright and more compact, while with a vase-formed tree it should be the object to cut to an outside bud each year.

L. C. CORBETT,
Washington, D. C.

Pruning Comice Pears
Rogue River Valley

The methods of bringing pear trees into bearing by pruning have often been written and discussed by authorities all over the country. The conclusions are varied, and necessarily so, owing to the influence of soil conditions, climate, location and method of handling the trees by the grower during their life. It is a difficult matter to make set rules, but a great deal can be accomplished by proper attention to pruning. In fact there is no more satisfactory way of bringing pears into bearing than by a careful and judicious use of pruning.

Experience has shown to many growers in Rogue River valley that the time of the year does not make so much difference in the matter of pruning for fruit as the method of doing it and the age of the tree to be pruned. It is an easy matter to induce wood growth in young pear trees on good soil, but it is not always so easy to bring them into bearing.

Several years' experience with Bosc and Comice pears growing on good soil and in a climate especially adapted to these varieties have induced me to believe that most growers are prone to overprune their young trees. In order to get the best results the trees should be carefully planted and from then on must be carefully pruned each winter, cutting well back to induce a healthy, stocky growth of wood. For four or five years the trees

should be pruned while in the dormant state (in fall and winter) with a view to getting the proper shape and foundation on the tree.

By the end of the fourth or fifth season the trees should all have acquired the proper framework for bearing fruit and from then on but little pruning should be done. That is to say, all heavy cutting and heading back should be absolutely discontinued. It will be necessary each year to remove water-sprouts and to thin out to some extent, but the ends of the branches should not be cut off as it will certainly promote the wood growth to the detriment of the fruit buds that should begin to form.

As stated, the first four or five years of the tree's life should be devoted to the growing of wood and so pruning as to make it grow in the proper shape. After that time the attention should be directed to the growing of fruit buds and fruit, and the shape of the tree more or less ignored. After the fourth or fifth year it is not important, in sections like the Rogue River valley, when the pruning is done. Some advocate summer pruning for fruit, but this often interferes with other work on the ranch. Besides this it is hard to see the framework of the trees through the leaves, and in pulling a leafy branch through the tree there is considerable danger of raking off the fruit spurs. It aids considerably if the water-sprouts are watched during the growing season and removed. This can easily be done by rubbing them off with the hands if they are not allowed much of a start.

It will require about two years from the time the heading back is stopped until the effect is observed, but if the pruning has been properly done the trees should begin to set fruit buds. To sum up: Cut heavily, especially in the winter, for wood growth; cut lightly and never head back if fruit buds are wanted.

A. C. ALLEN,
Hollywood Orchards.

Picking Pears

Picking pears depends much on the kinds to be marketed and the purposes for which they are intended. For instance, if pears are designed for long shipment, they should be picked a little greener than if they are intended for the nearby markets. The Bartlett pear may be picked before it is fully grown if it is desired to do so in order to reach an early market or to lighten the tree of a too heavy burden. In this state if it is wrapped in paper and placed in a dark room or cellar it will ripen nicely and be of excellent flavor. Some skill is necessary in order to determine by the size or color whether the pear is well enough developed to ripen and retain a good flavor, or whether it will wither and be unfit for use. This is one of the arts of the trade, and the pear grower will know first by picking and testing a few, and later as he has gained experience his eye will be a sufficient guide. In Bartlett pears there are generally three and sometimes four pickings, the largest and best-developed being picked first, and then a few days later others will have developed to a marketable size. Later still others will have developed, and so on until the whole crop is marketed.

Generally Bartlett pears are considered large enough to pick when they measure two and one-fourth inches in diameter. The Comice, being a larger pear, would measure much larger than this at the proper time for picking, while the Winter Nelis, being a small pear, would not at the proper time for picking measure so much. A good rule by which the amateur can judge as to the ripeness of the fruit is to bend the pear back. If on being bent back the stem separates readily from the spur, it is ready for picking. Care should be taken to not pull off the fruit spur nor handle the fruit roughly.

Utensils for Picking

The picking equipment for pears is much the same as for apples. A bucket with a canvas bottom is good, or a sack called a "picking bag," according to the taste of the grower or his notion of what can be best used by his pickers.

In hauling fruit from the orchard "lug boxes" are necessary. These boxes are

larger than the packing boxes, have strips nailed across the top to prevent the bruising of the fruit when the boxes are stacked level full, and have handholds cut or sawed in each end in order to make the lifting of the boxes easy.

Strong ladders are an important part of a picking equipment because a shaky ladder causes the picker to be afraid of falling, makes it harder for him to pick and often causes the bruising of the fruit. A low-wheeled one-horse wagon with a broad platform extending out over the wheels so as to hold a large number of boxes placed one tier on the platform is a good equipment for hauling in the fruit.

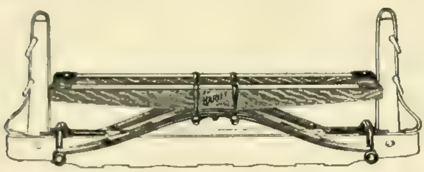


Fig. 1 "Harvey" Bolster Spring Suitable for Use on Orchard Wagons.

After the fruit is hauled to the packing sheds or house it is assorted by some one who attends particularly to that work and placed on the packing tables. In assorting there are certain rules in almost every commercial orchard which will govern the conduct of the work. These rules are determined by the object of the grower or the purposes for which his pears are intended. If they are intended for canning, one set of rules would obtain, while if they were intended for wrapping, boxing and sending to the city markets, another set of rules would be given.

In the Eastern states, for canning purposes pears are almost always shipped in baskets, while in the West, especially the Pacific Coast states, they are wrapped in paper and shipped in boxes.

Packing Pears

Where pears are packed in boxes for the fancy markets it is important that the same care should be used as in the packing of apples. Some of the commission merchants and fruit associations send out rules for packing similar to the following:

1. All packers must be registered. Each packer must have a rubber stamp with a number, and this number must be placed on every box packed by the one holding this number.

2. There must be a competent foreman over all packing crews, and each packer must look to him for instructions.

3. If any packer whose work is found unsatisfactory will not do the work as directed by the foreman, he shall be discharged.

4. All pears shall be packed in two grades, "Fancy" and "Choice." Some growers and associations have three grades, the same as in apples, "Extra Fancy," "Fancy" and "Choice."

Easter. Kieffer. Howell.

5. Extra fancy consists of "every pear substantially perfect." Fancy consists of pears at the proper stage of ripeness, free from diseases, bruises, worms, worm stings or other defects. Choice consists of pears of the proper degrees of ripeness, free from diseases of any kind, but may be limb-rubbed, misshapen or have worm stings, but not worms.

See also article on *Packing*, under *Apples*, page 326.

Time for Picking in the Yakima Valley

VARIETY	Time Picked in each District as shown by the following:				
	White Bluffs, Hanford and Kennewick	Donald and Parker	No. Yakima	Zillah, Prosser, Granger, Grandview, Sunnyside	Selah and Naches
Bartlett	8– 2 to 8–20	7–27 to 8–31	7–30 to 9–12	7–25 to 9–11	8–10 to 9–11
Buerre d'Anjou		9– 5 to 9–10	9–10 to 9–20	9– 3 to 9–24	9–13 to 9–28
Buerre d'Clarge			9– 7 to 9–20		
Buerre d'Easter			9–21 to 10– 9		
Clapp's Favorite	7–22		7–24 to 8–13	7–25 to 8–16	8–10 to 8–21
Comice			9–10 to 9–18		
Duchess			9–11 to 9–20		
Flemish Beauty	8– 2 to 8–20	8–1 to 8–31	8– 3 to 9– 1	8– 3 to 9– 6	8– 3 to 9–10
Fall Butter			8–30 to 9–30	9– 1 to 9–30	
Garber			8–30 to 9–21		
Howell					
Idaho			9–16 to 9–28	9– 1 to 9–20	
Jersey				9– 6 to 9–30	9–14
Kieffer			9–21 to 10– 2	9–20 to 10– 1	
Le Conte				8–27 to 9–14	
Seckel			9–12 to 9–28	8–22 to 9– 1	9–24
Vicar of Wakefield			9–21 to 9–26		
Winter Nelis			9–28 to 10–15	10– 2	
Winter Bartlett			9–28 to 10– 9	10– 2	
Walla Walla Seedling			8–26 to 9– 2		

Compiled by C. L. Hamilton.

PEAR PACKS

Three-Two, Three-Three and Three-Four Packs

Fig 1 shows how to start the first layer of each of these packs.

Three-Two Pack

This is a four-layer or four-tier pack. To begin the three-two pack, place three pears blossom end down in the order shown in Fig. 1A, 1, 2, 3. Then reverse the pears by placing them stem end toward the packer and again follow the numerals in the figure, 4, 5, 6, 7, 8, 9.

Fig. 1. Shows How to Start a Three Two Pack, A: Three-Three Pack, B; Four-Three Pack, C.

To place the second layer begin by putting two pears blossom end down in the pockets of the first layer, then reverse by placing the pears stem end down as before.

The third layer is laid like the first, the fourth like the second.

Four-tier counts of three-two packs:

No.	No. in Box	No. in Rows	No. of Layers
1	70	4 3	4
2	80	4-4	4
3	90	5-4	4
4	100	5-5	4
5	110	5-6	4
6	120	6-6	4

Three-Three Pack

When the pears are small enough to make a straight row across the end of the box, as in Fig. 1B, they are packed in a three-three pack. This is a five-layer or five-tier pack.

To begin this pack place three pears blossom end down in the end of the box in the order named in Fig. 1B. Then reverse and place three pears in the order shown. Now proceed as shown in Fig. 3.

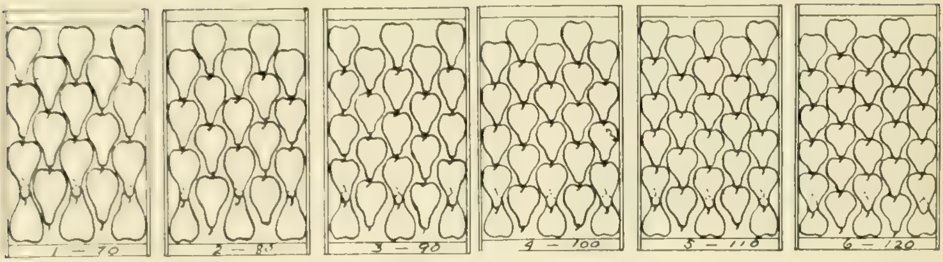


Fig. 2. Shows the 4-Tier Counts of the Three Two Pack.

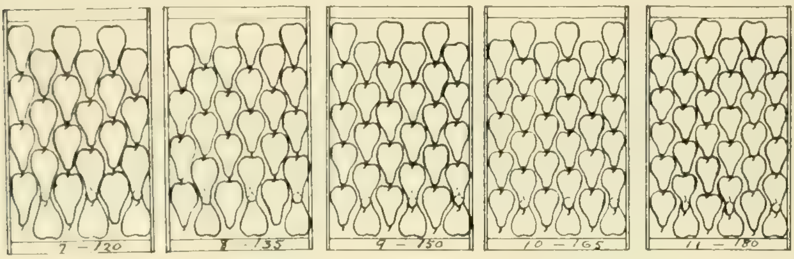


Fig. 3. Shows the 5-Tier Counts of the Three-Three Pack.

Place other layers as indicated for the three-two pack.

Five-tier counts of the three-three pack:

No.	No. in Box	No. in Rows	No. of Layers
7	120	4-4	5
8	135	5-4	5
9	150	5-5	5
10	165	6-5	5
11	180	6-6	5

Four-Three Pack

When the pears are small enough to make a straight row across the end of the box as in Fig. 4, they are placed in a four-three pack. This is a five-layer or five-tier pack.

To begin this pack place four pears blossom end down in the order shown in Fig. 1C. Reverse and proceed as before.

Five-tier counts of the four-three pack:

Fig.	No. in Box	No. in Rows	No. of Layers
12	193	6-5	5
13	210	6-6	5
14	228	7-6	5
15	245	7-7	5

(Illustrations Courtesy S. S. Busch)

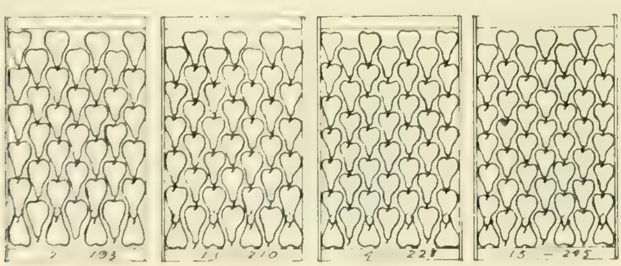
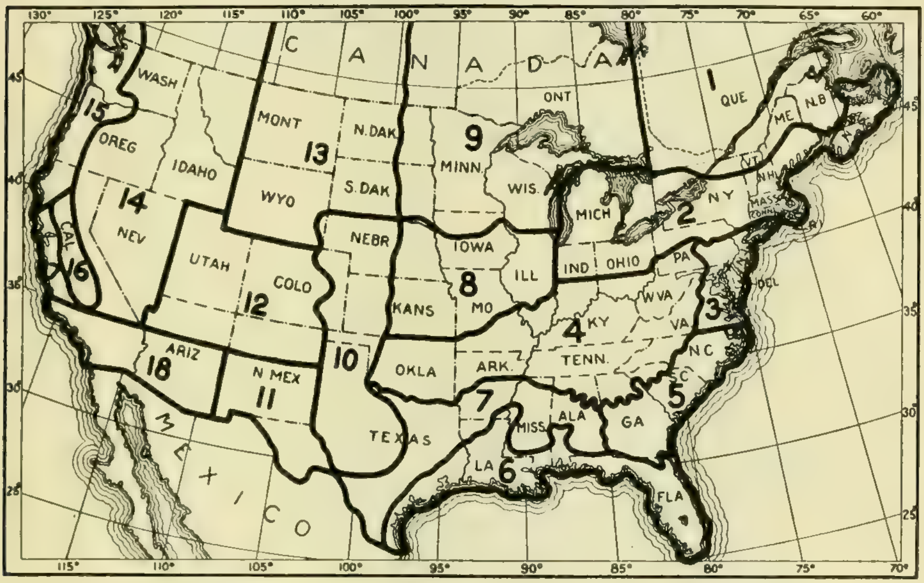


Fig. 4. Shows the Counts of the Four Three Pack.

VARIETIES TO PLANT

As an indication of current opinion on the best varieties of pears to plant in the various districts, the following tables are given, having been compiled from reports of nurserymen throughout the United States. The varieties are given in the order of importance based on the largest number of nurserymen reporting the variety amongst the best sellers.

The numbers at the head of the columns are those of the American Pomological Society Districts for 1909. Districts not reporting are omitted. See accompanying map.



MAP SHOWING THE POMOLOGICAL DISTRICTS OF THE UNITED STATES AND CANADA.

DISTRICT NO. 2

Best Sellers

Bartlett	Kieffer

DISTRICT NO. 3

Best Sellers

Bartlett	Kieffer

DISTRICT NO. 5

Best Sellers

Bartlett	Le Conte
Kieffer	Wilder
Seckel	B. d'Anjou
Koonce	Duchess
Garber	

DISTRICT NO. 8

Best Sellers

Bartlett	L. B. De Jersey
Kieffer	Seckel
Garber	Sheldon
Lincoln	Vermont Beauty
Duchess d'Aug	Vicar of Wakefield
Flemish Beauty	Alton
Longworth's No. 1	Crummel Oct.
Rossney	Stark Early
Belle Lucrative	Anjou
Howell	

New Varieties

Winter Bartlett	Lincoln

DISTRICT NO. 12

Best Sellers

Bartlett	Anjou

DISTRICT NO. 14

Best Sellers

Anjou	Flemish Beauty
Bartlett	

New Varieties

Dempsey	Pratt's Seedling
Rossney	Bosc
Comice	Winter Bartlett
Kennedy	

DISTRICT NO. 15

Best Sellers

Jules de Guyot	Flemish Beauty
Bartlett	Winter Nelis
Anjou	Comice

New Varieties

Jules de Guyot	Princess
Emile d'Heyst	

Best Sellers

Best sellers as indicated by the largest number of nurserymen reporting a given variety.

Bartlett	Belle Lucrative
Kieffer	Howell
Anjou	L. B. De Jersey
Seckel	Sheldon
Duchess	Vermont Beauty
Flemish Beauty	Vicar of Wakefield
Garber	Alton
Lincoln	Comice
Koonce	Crummel Oct.
Le Conte	Stark Early
Wilder	Jules de Guyot
Longsworth No. 1	Winter Nelis
Rossney	

New Varieties

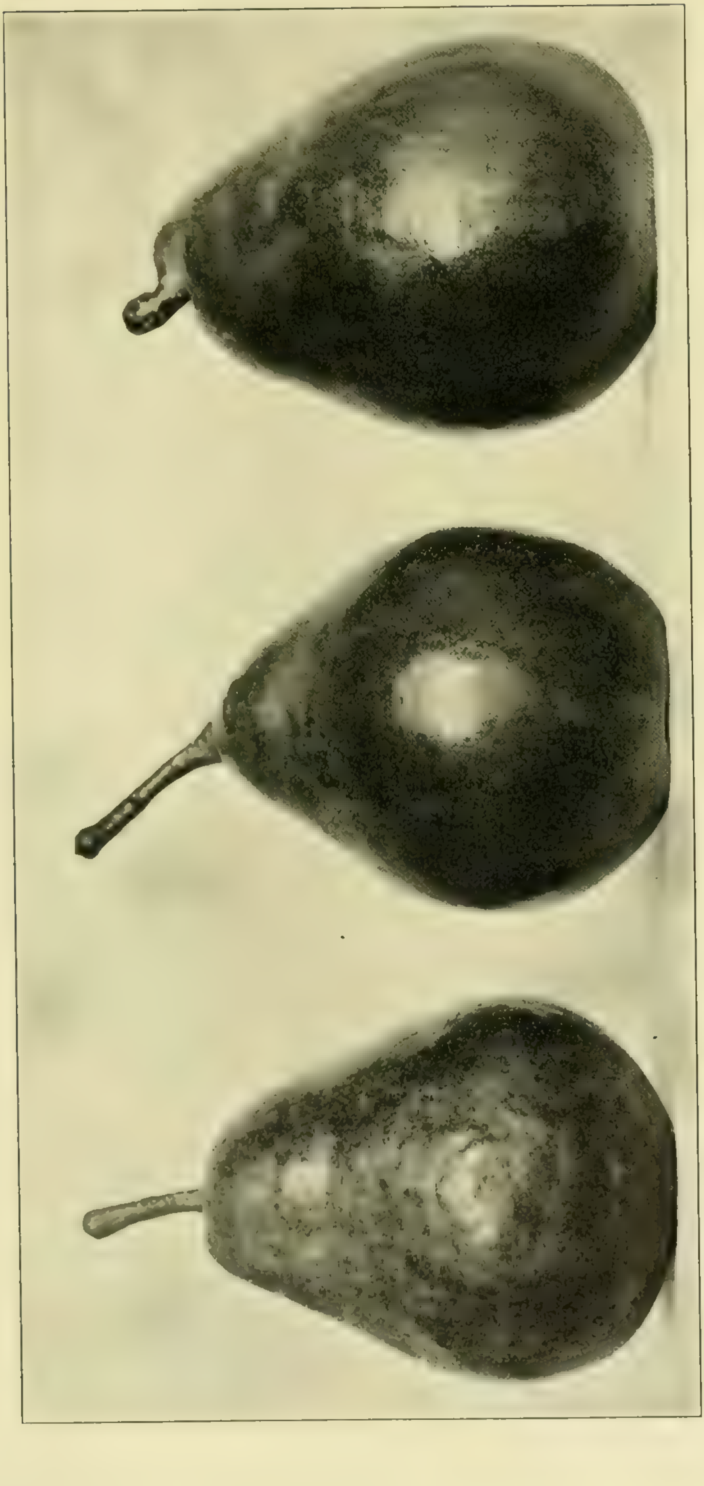
Winter Bartlett	Comice
Lincoln	Bosc
Dempsey	Jules de Guyot
Rossney	Emile d'Heyst
Kennedy	Princess
Pratt's Seedling	

PRICES RECEIVED FOR PEARS, ROGUE RIVER ASSOCIATION, 1911

	Fancy		Choice	
	4-Tier	5-Tier	4-Tier	5-Tier
Bartlett	$1.12	$0.785	$0.80	$0.748
Clairgeau	1.245	1.233	0.987	0.95
Howell	2.245	2.207	1.979	1.902
Anjous	2.24	2.329	2.00	1.884
Bosc	2.56	2.54	2.018	2.051
Winter Nelis	2.12	2.034	....	....
*Comice			2.35	1.042
Comice			2.80	1.133

* Half Box.

(Better Fruit, May, 1912)



Bartlett Howell Anjou —*P. J. O'Gara*

Pear Trees in the United States

The number of bearing pear trees in the United States, according to the census of 1910, is reported as follows:

(Scale, 3 cm=1,000,000.)

New York, 2,141,596.

California, 1,410,996.

Michigan, 1,136,151.

Ohio, 899,019.

Pennsylvania, 796,882.

Illinois, 786,340.

New Jersey, 731,616.

Indiana, 708,723.

Missouri, 606,937.

Texas, 558,478.

Virginia, 457,177.

Delaware, 449,692.

Maryland, 540,583.

Kentucky, 337,355.

Kansas, 292,383.

Washington, 290,676.

Oregon, 273,542.

Georgia, 262,982.

Tennessee, 233,407.

Arkansas, 221,764.

Oklahoma, 207,271.

West Virginia, 154,908.

Alabama, 142,300.

Mississippi, 118,556.

Massachusetts, 113,365.

Florida, 110,709.

South Carolina, 105,251.

Colorado, 99,989.

Utah, 79,355.

Idaho, 65,113.

Nebraska, 59,285.

Louisiana, 57,603.

Connecticut, 56,788.

Maine, 46,683.

New Mexico, 37,220.

New Hampshire, 36,816.

Wisconsin, 29,841.

Vermont, 26,315.

Rhode Island, 16,907.

Arizona, 16,351.

Montana, 10,297.

Nevada, 3,926.

South Dakota, 1,844.

Wyoming, 178.

North Carolina, 138.

North Dakota, 24.

Minnesota, no pears reported.

Production of Pears in United States
Trees, Production and Value

DIVISION OR STATE	1910		1909		1899
	Trees of bearing age	Trees not of bearing age	Production (bushels)	Value	Production (bushels)
United States	15,171,524	8,803,885	8,840,733	$7,910,600	6,625,417
Geographic Divisions:					
New England	296,874	97,650	233,845	258,816	183,728
Middle Atlantic	3,670,094	2,123,242	2,185,204	2,029,040	2,185,165
East North Central	3,560,083	1,441,505	1,623,176	1,331,712	782,265
West North Central	1,154,426	589,140	213,678	239,838	86,804
South Atlantic	2,325,714	880,461	975,162	680,275	745,294
East South Central	831,618	506,959	536,422	450,042	180,128
West South Central	1,045,143	936,230	191,518	192,736	225,265
Mountain	312,449	417,182	268,205	371,306	133,482
Pacific	1,975,123	1,811,516	2,613,523	2,356,835	2,103,286

Pears, Grade Rules. See under *Apple Packing*.

Pears, Pollination of. See under *Apple*.

Pears, Self-Fertile and Self-Sterile Varieties. See *Pollination*, under *Apple*.

PEAR DISEASES

Anthracnose. See *Apple Diseases*.

Black Leaf

In this disease one side or one limb of the pear tree dies and the leaves turn black and hang on for some time. The effect is quite similar in a general way to that of pear blight, but there is no sign of the presence of the pear-blight-causing organism as indicated by the red, juicy inner bark of limbs and twigs affected with the real blight. Sometimes there is connected with black leaf a dying of the bark extending in a narrow strip of uniform width down the trunk to the ground. All phases of this disease are distinguished from the true blight by the fact mentioned that there is not present the red, juicy condition of the inner bark, but the bark simply dies down and becomes very hard and dry from the first. This trouble also often occurs in orchards where the blight is not present and does not show the characteristic spreading of blight from tree to tree through the blossoms or by infection of young shoots and suckers.

The disease appears to be more of the nature of sour sap, connected most commonly with an excessive amount of moisture in the ground during the winter and spring. Where individual limbs are affected or narrow strips of bark on the side of the trunk, it appears that certain roots have been badly injured and that the portions affected above ground correspond with such roots.

R. E. Smith,

California Experiment Station Bulletin 218.

Black Rot. See *Apple Diseases*.

Blight

The Bacterial Blight of Apples, Pears, Quinces and Other Pome Fruits

Bacillus amylovorus (Burrill) De Toni

P. J. O'Gara

Pathologist

In the preparation of this article on pear blight the writer has in mind the many requests that have been made for a complete discussion of this subject. Although a large number of pathologists have studied pear blight from the laboratory standpoint, very few have ever carried out successful experiments in its control. To the United States Department of Agriculture belongs the credit of working out the methods of control and putting them into practice. The field work has been carried out in the East and South, and on the Pacific coast in California and Oregon, where excellent results have been obtained.

Early History and Native Origin

In going over the literature on pear blight we find a long array of articles which describe the disease fairly well,

but in the earlier accounts the conclusions concerning the cause of the disease are erroneous. The earliest record we have of pear blight was published in the "Transactions of the Massachusetts Society for the Promotion of Agriculture," in 1794. This report contains a letter written by William Denning, December 22, 1793. He first saw the disease on the highlands of the Hudson in 1780. He also noted that, besides attacking apples, the malady also affected pears and quinces. Subsequently, others reported its occurrence on Long Island and in New Jersey and Pennsylvania in the vicinity of Philadelphia. It also seems to have appeared quite general in the apple and pear orchards in the Eastern states, and following the settlements in Ohio, Indiana, Michigan and Illinois we find that the pear blight appeared and attacked the young pear and apple orchards. It was also well known that the disease occurred on wild crabapples and hawthorns of the Eastern states, but, singular as it may seem, it was unknown until about 1910 in Europe and Asia, where the pear and apple are native. These facts point to the Eastern United States as the native home of this disease and that wild fruits of the pome family, such as crabapple, hawthorn, mountain ash and service berry, are its native host plants. It injures these trees, however, to a very much less extent than it does the more sappy and vigorous growths of the cultivated pear, apple, quince and other fruits of the pome family. It is very important that every one should know that the pear and apple are not the only species of the pome family that may be destroyed by blight. In some recent publications it has been noted that no reference has been made to any other species of the pome family than the pear and apple. This is a serious mistake. Orchardists should know, for instance, that the quince is most seriously attacked by this disease. The writer knows an instance where an entire district became infected through a single case of blight which had its starting point in a loquat. Therefore, let it be understood that the pear, apple, quince, loquat, haw, service berry and mountain ash are all more or less subject to this disease. To a limited extent the disease also affects some plums and the apricot. It has been noted as attacking the blossoms and young shoots of the latter varieties of stone fruits. However, from a pathological standpoint, it cannot be considered as a serious disease for any of the stone fruits.

Although the disease was known as early as 1780, it was not until 1878 that Professor T. J. Burrill, of the University of Illinois, one of the pioneer plant pathologists, discovered the true nature of this disease and named the organism which causes it, namely, *Bacillus amylovorus*. From the early date when pear blight first became recognized as a disease up to the time that Professor Burrill discovered its true cause there had been much discussion regarding it, but most of the discussions are of little interest at the present date. I may also add that even now there are many so-called fruit growers who do not care to believe the facts now so well known to every worker in plant pathology. Rather than believe the unquestioned facts which have been made known by the microscope, they are even willing to delude themselves by such explanations as were given by those who first recognized the disease—such as lightning, frost, heat and various other causes. Dr. Burrill's discovery of the nature of pear blight is of striking and fundamental importance inasmuch as it was one of the first, if not the first, bacterial diseases of plants to be discovered. A Dutch botanist, Dr. Wakker, discovered a hyacinth disease about the same time to be of bacterial origin, and it may be said that this is the only rival in priority to Dr. Burrill's pioneer discovery. At this time, research along the lines of plant pathology, especially along bacteriological lines, was not being carried on with a great deal of vigor, and even after the above-named discoveries of Dr. Burrill and Dr. Wakker, a good many prominent bacteriologists hesitated in accepting this work with any great

degree of confidence. It was well known at this time that certain human diseases were caused by bacteria, but most bacteriologists were quite unwilling to think that vegetables could be invaded by germ life.

Dr. Burrill's announcement of the bacterial nature of pear blight was not accepted until Dr. J. C. Arthur confirmed it by a series of brilliant experiments which were made during the seasons of 1884 and 1885. His results were published in the proceedings of the American Association for the Advancement of Science, for the year 1885. This paper was read at Ann Arbor, Michigan, in 1885, and produced a great sensation. Although Dr. Burrill discovered the true nature of the pear-blight disease, the work of Dr. Arthur was needed in order to give Dr. Burrill's theory credence in this country. After Dr. Arthur's paper, no man had any doubt as to the nature of pear blight; at least, no scientific man.

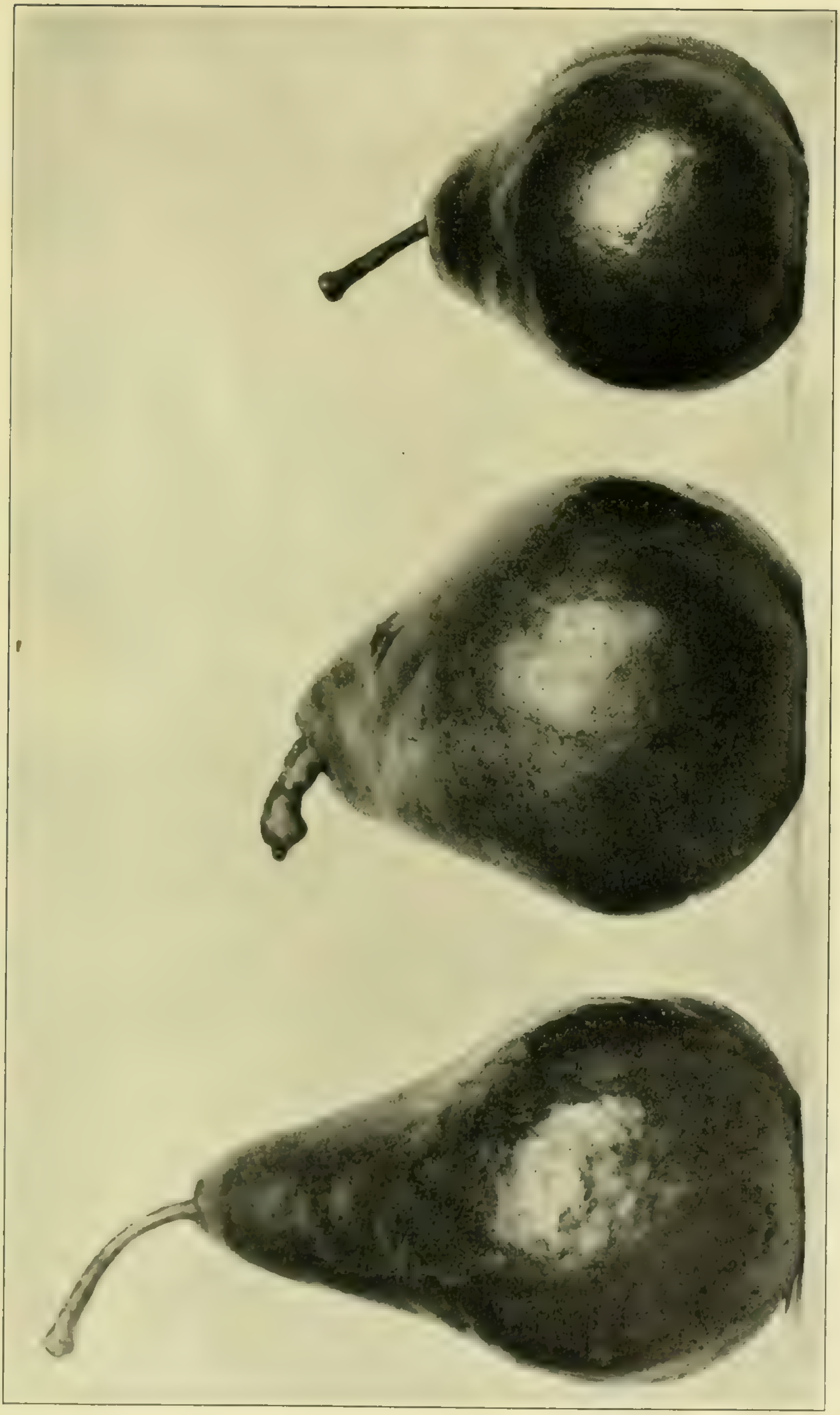
That Dr. Burrill's discovery was doubted by many eminent men should cause little wonder, because at that time there were fewer advantages and fewer laboratories equipped for scientific research than there are now. Even at that time the great Dr. Koch, the eminent German authority on tuberculosis, had not yet discovered the cause of this disease. However, since the initial discovery of the bacterial nature of the pear-blight disease, investigation of its nature and the life history of the germ have proceeded along the lines of modern bacteriological methods until at the present time we have as complete a knowledge of the pear-blight germ as the doctors or physicians have of the typhoid germ or germ of tuberculosis. In the spring of 1889 Professor M. B. Waite, pathologist of the United States Department of Agriculture, was assigned the task of investigating the pear-blight disease. At the time when he began his work, while the disease was known to be of germ origin, the life history of the germ was not known. No one had yet found out where the germ remained during the dormant period of the trees; that is to say, during the fall and winter. It had been supposed that the germ lived in the soil or in swamps, if such were near by, and that during the spring when the blossoming season began these germs were blown by the winds into the blossoms, and infection again started. Professor Waite, after an enormous amount of experimentation, found that the germ did not live in the soil; furthermore, he found that it did not blow about in the winds, but that the germ lives during the dormant period of the tree in "cankers," produced by the germ during the growing season.

In the Eastern states pear blight has done an enormous amount of damage in the past, more so than the Pacific Coast orchardists realize. In fact, one of the reasons for the commercial success of pear growing on the Coast has been the difficulty or inability of growing the better varieties of pears in the face of attacks by this disease in most sections of Eastern states. During the past few years pear blight has been very serious in New York, Michigan and generally throughout the East. The same may be said of the Southern states, such as Georgia and Florida. Usually, blight has been less severe in Michigan and New York, especially in the cooler, more damp sections in the vicinity of the Great Lakes; however, in Niagara county, New York, which borders on Lake Ontario, there have been serious epidemics of pear blight. There are many Bartlett pear orchards throughout the northern portion of the Eastern states, but southward of this, Bartlett pear growing is almost abandoned. The Oriental pears are more resistant and more adapted to the climatic conditions in the South, and hence are grown quite extensively, or were at one time. Within the past few years the Le Conte and Kieffer varieties, grown principally in Georgia and Florida, have been practically wiped out by pear blight. At one time these varieties were shipped into New York from the South by the trainload. Apples have also suffered to a very great extent, although, as a rule, in the commercial sections of New York, New England and Michigan but little damage has been done. Occasionally

Spitzenburg and other varieties have been very badly blighted; however, most of the trouble on the apple is due to blight in the blossoms or in the twigs, but on the Pacific coast it is not at all uncommon to see the Spitzenburg and crabapples entirely killed. With the Russian apples, such as the Yellow Transparent, Alexander, Red Astrachan, etc., the disease has killed trees just as it does pears. In the Middle West in the states of Illinois, Iowa, Nebraska and Kansas, the injury to the apples is found to be very severe. The rich prairie soils of these states, together with an ample supply of rainfall during almost the entire growing season, produces a rank growth which causes the trees to become very subject to the disease. The disease has moved steadily westward with the settlement of the country, but for a long time the wide stretch of plains free from orchards and giving no opportunity for the disease to lodge, resulted in complete freedom from this pest on the Pacific coast. It is only since about 1898 that the disease became known in Colorado, and about the same time we find its occurrence in the neighborhood of Vancouver, British Columbia. About 1901 the disease broke out in force in the San Joaquin valley, California, but it was probably two or three years developing before attracting much attention. It has finally resulted in the destruction of practically all of the orchards in San Joaquin valley, and has moved up into nearly all the districts of the great Sacramento valley, and in many of the smaller adjacent valleys. I know of only one valley, namely, the Santa Clara valley, which so far seems to have escaped infection. It is only through the efforts of the commissioners and inspectors in this valley that the valley has been kept free from this dreadful disease. To show the extent of the injury to California I may state that fully two-thirds of the pear trees of the Bartlett variety have been destroyed. As an instance showing the extent of this calamity, I note in the report for 1901 and 1902 issued by the California State Board of Horticulture, that Fresno county had 125,000 pear trees; Kings county, 43,700 pear trees; in 1903 and 1904 we find that Fresno county had only 1,500 and Kings county had none. The disease has moved slowly up the Sacramento valley, and by slow stages over the mountains into the Rogue River valley in Southern Oregon, where its distribution is general, but under complete control.

The blight infection now extends into the Umpqua valley some distance beyond Roseberg. Many have asked how the disease could have come from the upper Sacramento river near Redding, which is the northern limit of pear-growing in California, into the Rogue River valley, since there is a great mountain range separating the two localities. However, anyone riding over the Southern Pacific railway and being observant would notice that at every station along the railway, and even at intermediate places, pear and apple trees may be found; furthermore, it may be noted that these pome fruits have blighted more or less seriously, depending, of course, upon the varieties as well as upon the care given the trees or the type of soil in which they are growing. These small plantings, together with the native pome fruits, have been stepping stones for the blight germ in its passage from the upper California orchards to the orchards of the Rogue River valley.

The blight infection which we find in British Columbia is an extension of the Colorado infection which has passed through the Salt Lake country in Utah, and northwestward through the state of Idaho and through Eastern Oregon and Washington. Therefore, the Willamette valley, together with the orchards northward and west of the Cascades, have not yet been invaded. In other words, the two infections from the south and the north have not yet met, but it is only a question of time when they will come together. When blight does finally reach these untouched districts the climatic conditions will tend to favor infection to a great degree. The increased rainfall as well as the late spring and summer precipitations favor infection, and add difficulties in the way of control. The



Bosc Comice Winter Nelis

P. J. O'Gara

above statements are made in order that all districts which are still free from blight will make a hard fight to keep it out. There is every reason to fear blight and to fear it all the time.

There is a common impression among some of the older residents of the Rogue River valley that pear blight existed in the valley eighteen years or more ago. An unpublished "History of Pear Blight in Rogue River Valley" is one of the best historical evidences that the blight did not exist so long ago. The statements that certain varieties of pears which are known to be practically immune were badly affected and those very susceptible to the disease remaining untouched, even though alongside the blighted varieties, is proof positive that the trouble was really something else. Furthermore, the quince and the Spitzenburg apple were not noted as having been attacked at all. Again, several orchards in which it was said that blight occurred eighteen years ago, had not come into bloom at that time. It is very rare that blight is troublesome before the trees come into bloom, and the reason for this we will show later on. The explanation which seems best to fit what many of the old settlers thought to be blight is that unfavorable soil and weather conditions was the real cause of the trouble. We know that undrained soils, especially if they are cold, have a bad effect on many varieties of trees, especially apples and some varieties of pears. The common term, "sour sap," is certainly the trouble they had in mind and not blight.

Pear blight did not infest the orchards of the Rogue River valley until the spring and summer of 1907. As a matter of fact, the real outbreaks were not found until past mid-summer. We know that this is true by our knowledge of the blight conditions in the upper Sacramento River valley. Beginning with the fall of 1907, when the writer first saw the Rogue River valley, up to the present time, the loss in the commercial pear and apple orchards has been comparatively small.

Host Plants

The disease is usually most serious on the pear. It attacks the apple, however, to a very serious extent, sometimes disastrously, as I have already noted. The quince, wild crabapple, various species of the hawthorn, the service berry, mountain ash and other wild fruits belonging to the pome family are more or less subject to its attacks. The loquat, which is a relative of the pome fruits, is a somewhat peculiar host for this disease. Some varieties of plums and the apricot are attacked in a small way by blight, but from a practical point of view the injury is not serious enough to attract attention. Wherever native shrubs or trees of the pome species are abundant in the neighborhood of pear and apple orchards, attention should be given them, and it would be better that they were destroyed. There is this much to say, however, the native shrubs do not, as a rule, tend to hold the blight over as do the cultivated orchards.

Appearance

The blight usually attracts attention in the spring of the year, and a month or so after the blossoming period. It is then found that the flower clusters are shriveling and dying; however, if examination has been made very carefully the blighted blossoms may be seen to have been infected for some weeks previous to this time. The twigs will also be found to be dying. In some cases the new shoots are seen to be attacked at the tip and the disease running downward, killing the tender twigs completely and running down the bark of the twigs and branches in the form of an ooze, which is slimy in appearance and somewhat sweetish to the taste. Usually blossom blight accounts for the greater part of the infection points, but in some cases twig infection exceeds blossom infection. If the season is favorable and the other conditions are just right, the disease may not run further than a few inches. It may kill only the blossom clusters or the fruit spur a few inches down the twig and then stop. On the other hand, if conditions are very favorable for the tree,

which means favorable to the blight germs, the disease may run down into the main limbs and branches, and in extreme cases, may continue running downward during the growing season, until it reaches the root system. Often it has progressed much further in the bark and cambium of the branches than appears on casual examination, for, as a general rule, it works only in the bark and cambium layers, leaving the mature wood unharmed.

Sometimes a very small strip of cambium is left unharmed and the sap, therefore, is able to continue to flow upwards so that the leaves and branches may still carry their foliage or often mature their fruit. Very often, too, the bark and cambium may be completely girdled, but the young wood is still able to conduct enough sap to keep the foliage and fruit hanging, and often allowing the fruit to mature. On microscopical examination of the diseased tissues they are found to be completely filled with countless millions of minute germs. These germs are mixed with a gummy, sticky material formed by the sap of the tree. The disease is therefore more in the nature of fermentation, or perhaps we may say a gangrene of the bark and cambium produced by the invasion of an immense swarm of bacteria. The bacteria proceed in all directions from the point of infection; that is, when they go down a twig or spur or a water-sprout into the branches or bodies of the trees, there is a development of the disease from this point upwards and downwards and laterally. On account of the vessels and fibres of the bark the most rapid development is lengthwise, that is to say, upward and downward on the branches.

The disease has a tendency to develop in the green, fleshy or outer bark of the branches. The branches of the pear tree usually remain smooth up to eight or ten years of age, sometimes for a longer period. During this time, the fleshy outer bark grows as fast as the limb grows, but later on the outer layer dies and is converted into firm, corky material, or the characteristic rough bark of trees. This formation of rough bark often puzzles the orchardist in getting out pear blight, as the dead spots resemble, to some extent, the appearance of blight. However, a little study will soon enable one to recognize the rough-bark formation by cutting through the dead layer to the fresh, smooth bark which is found underneath.

It may be stated here that where the bodies of trees are covered with the rough bark and these sunken spots of bark are just beginning to die, the only method of inspection should be by digging out a small chip with a gouge, so as to expose the inner bark, and thus be able to tell whether or not there is any infection in the tree. Sometimes the blight runs in the green layer, leaving untouched the slightly tougher inner bark, but such cases can be easily recognized from their connection with blighted bark above or below. When blight is working in the tissues it invades the vessels of the bark, the intercellular spaces, and besides often breaks down in its progress little pores or channels, or sometimes large lenticular spots which become filled with some of the gummy matter. This very frequently exudes in tiny drops not larger than a pinhead, or sometimes forms on the bodies or branches as copious gum masses flowing downward on the bark. When this exudate comes from newly invaded tissues in the summertime it is milky white from the numerous germs present in the liquid. Later, the gum oxidizes into an amber yellow or slightly brownish, then finally into a dark brown or almost black gum. Sometimes when it exudes from the bark or larger branches it is reddish brown from the beginning; occasionally it is quite red in appearance, getting its color from the red decomposing bark. When the blight is running rapidly in the tissues, the margin is at first merely water-soaked, or very slightly water-soaked in appearance. This is particularly to be noted in the bark and infected young fruits of apple, pear or quince. Later on various stages of its discoloration follow as the germs fully occupy and decompose the tissues.

The Germ

The germ causing this disease is named by bacteriologists "*Bacillus amylororus.*" For our purpose of discussion we may call it the pear-blight bacillus, the pear-blight germ or the pear-blight microbe, all these terms meaning practically the same thing. These germs are among the most minute of living things. Bacteria or germs are vegetable organisms, and are as truly plants as trees, grasses, etc. However, they are very low down in the scale of the vegetable kingdom since the individual organism consists of a single cell, which may be elliptical or rod-like in form. They multiply by lengthening a little and then pinching in two. This is the only way in which they may increase their numbers. This process can take place within half an hour or less, and this I have proven by observation in a hanging drop culture under the microscope. Although they are extremely minute they may be measured by means of microscopical apparatus. The standard of measurement for these minute objects is the micromillimeter, and a millimeter is about one twenty-fifth part of an inch. The pear-blight germ is from two-thirds to three-fourths of a micromillimeter wide, and from one to one and

Spitzenburg Infected with Pear Blight. Note the two streams of ooze running down the body. (Original.)

one-half micromillimeters long when it has reached its mature stage. As another illustration showing their minute size I may say that if 25,000 pear-blight germs were placed end to end they would scarcely measure an inch in length. Curiously enough, the young germs are longer than the older ones. When they are growing rapidly their development in length goes on more rapidly than their division. This germ forms no spores, and for this reason can not live over the dry season, as do the germs of anthrax which form spores. The pear-blight germ is very sensitive to drying, and, in fact, is a very short-lived germ. The fact that it does not form spores is highly important, as spore-forming bacteria are capable of living over in dust which may be blown about by the winds. The germ dies rapidly in the blighted tissues, as soon as the tissues have become fully killed. It cannot withstand drying, usually dying within two weeks or so. It is killed by exposure to direct sunshine in a very few minutes, usually not more than ten minutes unless protected by the bark or twigs. It rapidly dies when it is washed into the soil, since it can no longer get the necessary food for its existence and multiplication. In fact, the pear-blight germs disappear and die very shortly after they are exuded or washed out by the rains from the twigs and branches. It also dies when the blighted bark dries up. It can only live along the advancing margin of the disease in the thick, fleshy bark or cambium which has been invaded by the bacteria, and which does not have time to dry out until the cool weather approaches. The thick bark of the large limbs, branches and root system remains moist during a long period, especially in the winter. By this method, the importance of which we will show later, the germs are able to carry over, or live over, from one season to another. As a matter of fact, it is only by this means that the pear-blight germ can live over during the dormant period of the trees. The germs are killed by high temperature, they are wholly destroyed when subjected in liquid culture to the temperature of 55

degrees centigrade for ten minutes. They are wholly uninjured, on the other hand, by any degree of cold. Temperatures of 40 degrees Fahrenheit below zero have no effect whatever. They may be found to be frozen at this temperature, but thaw out immediately when plunged into warm water and go on with their activities uninjured. Cold retards their development, but it also prolongs their life. Like other vegetable organisms, cold storage has the effect of prolonging life over a long period of time. In the laboratory the organism lives for a relatively short time at room temperatures, while if the cultures are put into the icebox the germs may live for months, providing the culture medium does not dry out.

The Life Cycle

In the life cycle of this germ, blossom blight may be considered as the first step, at least this is the first step in its life cycle that is noticed by the casual observer. For a long time it was a great puzzle where the germs came from that produced the first blossom blight in the spring of the year. This one link in the chain, where the germs remained during the dormant season, was missing. No one knew how the first blossoms became infected. Given a number of blossoms infected, it was comparatively easy to discover the methods by which the germs were carried about. Not only in natural infections, but in those artificially produced with pure cultures, insects were found visiting the blighted blossoms. The germ multiplies in the nectaries of the blossoms as readily as it does in a laboratory culture medium, since the nectar glands exude a sugary solution which furnishes the organism the necessary food supply. The enzyme or ferment given off as a by-product by the germ dissolves the delicate cells beneath, permitting the germ to pass downward with the greatest of ease. Ordinarily, the entire pear tree is sealed up with an air-tight and water-tight cuticle composed of a thin layer of the same composition as cork. Even the breathing pores are plugged up during the dormant season of the tree so as to prevent evaporation from the tissues. This cuticle keeps out the pear-blight germ unless it is injured or broken. The nectary is not covered by cuticle and is, therefore, an easy place for the germs to enter. The gummy exudate pushes out of the infected blossoms, adding to, or even taking the place of the nectar; and honey bees, wild bees, wasps, flies, and perhaps fifty other species of insects visiting the pear blossoms or apple blossoms carry the germ-infected material. When once an insect's mouth parts and feet are infected, blossoms which it visits thereafter become in turn infected as the insect drops off a few germs into the nectaries. The blight virus being also a sticky material and usually requiring a considerable mass, speaking from the microscopic standpoint, to produce infection, is not blown by the wind. Of course, the negative of such a proposition is hard to prove conclusively, but experiments have been made to decide this matter by covering blossoms with mosquito netting along the side of artificially infected flowers, and it was readily found that the uncovered flower visited by insects contracted the blight, while those covered by bags, mosquito netting and other material which kept out insects remained free from the disease. Occasionally, a humming bird visits the infected blossoms. This has been observed in a number of instances. Doubtless, birds get the gummy material on their feet and carry the blight long distances. However, we look upon insect distribution as by far the most immediate means of infection, especially in blossoms, in carrying the blight from flower to flower, tree to tree and orchard to orchard, although doubtless occasional long-distance distribution is accomplished by birds or some other agencies, including man himself. After the blossoming period is over, or even before it is entirely finished, blight may be found attacking the tender twigs. Our common insects have been found to be active agencies in not only the distribution of the disease, but in puncturing the tissues and thereby introducing the germs into them. While it is easy to

Bartlett Pear Tree Showing the Blight Eradicated from the Body. It was necessary to cut part of the root system away. This tree is capable of bearing a normal crop. (Original.)

prove that insects cause some of the infections of some of the twigs, it is not absolutely certain that they do all the inoculating. Twigs are sometimes found with blight started in the axils of the leaves or in the tender bark where no punctures can be found on careful examination. It is possible that the germ may enter in damp weather through growth cracks where the cuticle is ruptured, exposing the tender tissues.

Means of Infection

That insects really carry pear-blight germs on their feet and mouth parts, I have proved by capturing these insects in infected orchards and allowing them to walk about on prepared culture plates known as Petri dishes, which contained a substance in which germs might make growth. In from 24 to 48 hours colonies of germs would be found growing from the points where the insects walked upon the culture medium. By inoculating growing shoots from these cultures, typical cases of blight were produced.

Numerous experiments have been made by atomizing the germs on trees. These have been failures, except where punctures through the cuticle have been made by a pin point, or where by the breaking of the leaf or some slight abrasion the skin has been ruptured, allowing the germ to enter.

There are, therefore, two main methods of entry by the germ. First, in the nectaries of the blossoms, and second, the tender tips of growing twigs or watersprouts on bodies and roots. Blight occasionally enters by the third method — directly into the tender, growing, fleshy bark, through growth cracks. Sapsuckers or woodpeckers become infected by puncturing cases of holdover blight, and afterwards visiting healthy trees produce blight infection in them. We have several observations along this line, and doubtless many more occur in nature. It is even possible for the whiffletrees or implements used in culti-

A Bad Crown Infection on Spitzenburg Apple, Due to Water Sprouts. Poor attempt at working out the infection. Note ooze running down the body above the part cut out (Original.)

vation to transfer the infection; pruning tools are certainly a very frequent cause of transmitting the disease, especially during the growing season.

Mr. Waite states that in Maryland he saw a nursery block of 10,000 Bartlett pear trees completely destroyed by blight. This block carried actual cases of hold-over blight in the stocks. When stocks were cut off above the dormant buds in the spring, the pruning tools became infected and the disease was transmitted to nearly every tree cut back by the pruner. Instead of the buds starting growth, the cut surface began to blight. The writer has seen in certain nurseries in Nebraska many cases where nursery infection has been brought about through the use of tools which had been used in cutting out blight infection in large orchard trees without previously disinfecting them. Pear blight behaves in all sorts of irregular ways when it runs down the limbs and branches. Occasionally a fruit spur blighting causes the disease to spread in a circular spot an inch or two in diameter on the branches. More often it is an elliptical spot extending lengthwise of the branch. It may run down in a long line from the lower edge, making it very difficult to save the branch or even the tree by cutting, on account of this narrow strip of the disease. It is almost impossible to anticipate the variations in behavior of the disease, because it depends upon so many different factors. It may be well to point out some of the factors controlling the habits of the disease in order that it may be seen how varied are the influences controlling it.

These factors may be divided more or less completely into two sets. First, those which govern infection, and second, those which determine the spread of the blight in the tree after infection.

The first factor is the presence of the bacillus. The pear-blight germ must be present in the orchard or must be carried there during the season in order to have the blight. No matter how favorable the conditions may be, unless the germ is there the disease cannot develop. The immunity of California and Oregon orchards up to recent years, of course, is attributed to the fact that the germ was not there. The second factor is the number of insect visitors. We have pointed out that insects carry the blight about. The honey bee is one of the most active in carrying the blight to the blossoms. Other insects visit the pear and apple blossoms and carry the blight very widely. The presence of certain species of insects, as already suggested, has been the means of introducing the blight into the twigs and branches or bodies of the trees. Not only must the insect be present and the germs there for them to carry, but the weather conditions must be favorable for the activity of the insects and to bring the trees into proper condition for infection.

Flower-visiting insects usually like sunshiny weather, especially sunny weather following a moist season, which allows many kinds to hatch out or develop from the pupa. Young orchards are not usually attacked by the blight, rather

Body Infection of Bartlett Due to Water-Sprouts. First attempt to eradicate the blight unsuccessful, and it was necessary to peel the bark and cambium at a greater distance (Original.)

rarely in fact, until they have blossomed, unless there is a bad attack of blight in a pear or other pome fruit orchard near at hand. There are some cases of young orchards which I have seen in California and Oregon that have blighted somewhat seriously before they had bloomed, but they were alongside badly blighted pear orchards. The presence of water-sprouts or spurs from the French stock, on which pear trees are mostly budded, often determines infection. In many localities the entire loss of the pear orchards has come through the infection of water-sprouts and spurs coming from the crown or roots of the trees. Perhaps 90 per cent of the loss in many of the river orchards in the Sacramento valley has come about through this sort of infection. Right alongside of orchards which have been seriously damaged through the infection of water-sprouts from the stock or roots we found thrifty trees which were budded on Winter Nelis and Kieffer. These have not gone down with the disease through their ability to resist the blight. It has been particularly noticeable that Winter Nelis is generally quite resistant. Cases have come under my observation where the bodies have blighted as far as the union with the Winter Nelis and Kieffer stock and then stopped. If this experience proves universal, it is a strong argument in favor of using the Kieffer and Winter Nelis on which to graft the more tender varieties. These varieties should be worked on Japan roots.

A Bad Infection in the Body and Root System. Only a small part of the root system left. This tree will continue to bear fruit. (Original.)

Several conditions or factors control the spread of the blight after it once enters the tree. Some of these are more or less connected with the conditions favoring infection. The vigor of the tree has a great deal to do with the amount of damage produced after the blight once enters it. Another fact which must be borne in mind is the variety of tree, whether apple or pear, or any other pome fruit. All varieties are not equally susceptible under similar conditions, there being in many varieties a certain tendency toward immunity. The more vigorous and thrifty the tree, as a general rule, the more seriously is it attacked by the blight. The vigor itself is the effect of various conditions, such as the fertility of the soil, the amount of manure or of commercial fertilizer used, or kind of cultivation of soil, moisture, rainfall or irrigation, and the presence of other diseases, such as leaf blight, crown gall, root rot, etc.

As a rule, trees on rich soil blight more readily than trees which are on poor soil. There are some apparent exceptions to this, and there is a difference in the behavior of blight on different soils in connection with their fertility. Alkali soils seem to favor the blight more than correspondingly fertile soils. On the other hand, trees may blight on the acid soils of the Eastern states. Stable manure causes the trees to be more susceptible to the blight than those not manured. The age of the tree also exerts an important influence. The older and slower growing the tree is, the less it is attacked by blight, other things, of course, being

equal. Exhaustive crops of fruit tend to consume the food material of the tree and help to check the blight to a certain extent. On the other hand, when the trees fail to fruit from unfavorable conditions, such as prolonged rains at the blossoming period, there may not be the opportunity for infection, and the contradiction to this principle may be observed. From observation, orchardists know that during rainy and cloudy weather insect visitors, such as bees, are very rarely found working in the blossom. Since the bees are the principal distributors of the blight germs, it can be readily seen that if the entire blossoming period is covered by rainy or cool weather there is little chance for very serious and general infection, although there may be considerable holdover blight in the vicinity of the blossoming orchards.

The style of pruning the tree exerts some influence not only on the behavior of the blight, but also on the convenience of the orchardist in eradicating the disease. The least desirable form of tree is the tall pyramid, having a central leader with the fruit spurs on the main trunk and water-sprouts at the base. In this form of tree, any infection of blossoms or sprouts readily goes into the body, making it difficult to eradicate the blight without practically destroying the tree, or at least removing the principal bearing area. The most desirable form is the broad vase-formed tree, clean and free from water-sprouts at the base, having no fruit spurs near the main trunk and leaders, and having lateral twigs for fruit-bearing at as great distance as possible from the crown of the tree. Such a tree is also in a very desirable form for other reasons, for it is easier to spray, easier to prune after the top has been formed, easier to gather the fruit, and especially easier to examine and keep free from blight.

The weather at critical times, especially in the spring and summer, exerts an important influence on the spread of blight. In fact, the weather influences dominate more equally the infection than they do the spreading of the blight in the trees. We recognize certain spells or weather conditions as infection periods, and by following carefully the relation of the blight to the weather the intelligent fruit grower soon learns to anticipate these difficulties. In fact, it was supposed by many that the long, dry, hot summer of the Western states, especially the Pacific Coast states, gave such poor opportunity for pear blight that it was not able to exist under the prevailing conditions. Of course, we now know that this is a fallacy, for, as soon as the germ was introduced, it produced the disease abundantly. Dry sunshine, while favorable to the orchards, tends to produce a firm, healthy growth of the tree and prevent infection periods. However, constant and intense sunlight produces another result which may be noted here. Pome fruits, as well as other fruits, under the influence of dry, but sunshiny weather, carry on their processes of growth and assimilation in the very best possible manner. The study of blight throughout the West shows that where irrigation is used on the one hand, and where there is a natural supply of water on the other hand, and where the orchards are kept in a continual state of high nutrition by the perpetual and uniform sunshine, the trees are peculiarly susceptible to the disease. In the lower Sacramento valley in California and in the Rogue River valley, where irrigation is not resorted to, we find that there is a great deal of soil moisture, and in many favored spots the water table is only a few feet below the surface of the ground. Under proper cultivation, where a dust mulch prevents evaporation of the soil moisture, we find that during even the driest seasons the roots of the trees are amply supplied with water. On the other hand, we also find places where the water table is too near the surface, and in this case the trees are in a drowned condition; consequently, perfect assimilation does not go on, and for this reason such trees, although situated in rich, nitrogenous soils, do not blight badly. Where the trees are growing at their best, the blight germ feeds on the rich sugars in the

sap, so that the conditions which favor the growth and production of the fruit also tends to favor the germ; for we must remember that the germ is itself a plant, depending upon the rich food supplied by the tree for its best growth. The fleshy bark of trees grown under constant sunshine, especially those of the Pacific coast, seem to be richer and thicker than in the Eastern states, and naturally affords an unusually good feeding ground for the pear-blight bacillus. This rich, fleshy bark also tends to hold over the germ during the dormant season in a much more serious way than the thinner bark of trees grown under other conditions. Cloudy, rainy weather, therefore, while favoring infection, sometimes results in a starved condition of the tree, which, of course, is especially unfavorable to the pear-blight germ. Trees grown so as to produce a minimum growth naturally are short of plant food, and of course do not favor the pear-blight germ, even though it should enter the tissues. Every physiologist knows that in order that a green plant may form starch in its foliage the action of sunlight is required. The more intense the sunlight the more rapidly the formation of starch goes on. In cloudy, dark weather very little starch is made or elaborated in the leaves. Of course, we know that the tree does not make use of its starch as such, but, through the action of a diastatic ferment or enzyme the starch is changed into sugar, which is translocated to all parts of the tree by osmotic action; that is, through the sap. It is this rich sap, which is mostly sugar, that the pear-blight germ feeds upon. The more sugar, the more intense the destructive action of the germ. The very regular growth of the trees in the Rocky mountain and Pacific coast orchards tends to keep the pear-blight germ continually at work, unless checked by prompt and thorough eradication. In the Eastern orchards, especially with dwarf pears, which make their growth early in the season, a heavy rain, if accompanied by a day or two of cool, cloudy weather, will cause the trees to form their terminal buds.

Before leaving the discussion of weather conditions, it may be well to point out more fully the reasons why serious outbreaks of blight occur after showers or thunder storms. It has been the common belief that static discharges of atmospheric electricity have a considerable influence upon such outbreaks. This, of course, is mere fancy and has no scientific significance whatever. Everyone knows that a seed planted in dry soil cannot germinate unless moisture is applied to it, either artificially or naturally. Now, supposing a thunder storm comes along with a heavy precipitation, or at least sufficient precipitation to moisten the soil about the seed, what happens? The question is so simple that a child in the primary grade would not hesitate in answering it. Of course, the seed starts into growth, the rapidity of its growth depending upon the temperature following the rainfall. Now, was it the rainfall or the thunder and lightning that caused the seed to germinate? It was the rainfall and the warmth, and nothing else. It has been explained that a germ or bacterium is also a plant, dependent upon moisture and heat for its growth. In a dry season an enormous number of infections may take place, but the very fact that the season is dry and warm accounts for the fact that these infections fail; just the same as in a very dry season a very large percentage of corn, or any other seed put into dry ground, will fail to germinate and we have an occasional plant coming up, just as we find in the case of blight, only a few infections appearing. Everybody knows that after a rain every vegetable starts into rapid growth providing the weather is warm. Now, rapid growth in a pear or apple tree means nothing more nor less than an enormous addition of water, plus food from soil and air to it. Here we have conditions favorable to the growth of the blight germ, which uses the pear or apple as its soil from which it draws its water supply and its necessary food, namely, starch and sugar. Just preceding a heavy

rainfall, the germs may have been distributed very widely. Had dry weather continued the fact that the germ had become widely distributed would not have become apparent because countless infections would not have taken. In very dry weather the nectaries of blossoms soon dry, and unless germs have gained a strong foothold before drying takes place no apparent infection results. The above explanation should suffice to show that the thunder and lightning theory has no bearing whatever on the disease known as pear blight. Consider the germ in the light of a seed whose germination is dependent upon the same environmental conditions for all of its growth activities.

To one who knows something of the theory of the disease, the matter of eradication often seems very simple. It is usually a very easy thing to write about the experiences of others and to tell in considerable detail how blight should be eradicated and controlled. The actual field work is very difficult and tedious, and a matter of days or months of training only will make an expert field man. No one can become expert after a few hours' work, even under competent instruction given by a trained man having had years of experience. We do find people, however, who are able to write and instruct without having had any experience whatever. To the initiated, as well as the uninitiated, let me say that the eradication of pear blight is one of the most difficult problems known to plant pathologists. Let no one say that it is a simple thing. It is difficult, very difficult. The reason for this difficulty is that we are dealing with a considerable amount of ignorance and unbelief; again, few farmers who have not had a bacteriologist's training realize the peculiar relation existing between the organism causing the disease and the host plants. They fail to see that this relation is practically the same as that which exists between the germ of tuberculosis and man. On the one hand, antiseptic precautions, and the removal of infections seems unimportant; on the other hand, however, long experience with this dread human disease instills a sort of fear, even though the true cause may not be fully comprehended. If every fruit grower could be made to feel that fruit trees are living things very much in the same sense as themselves, and that the parasites attacking them should be viewed in a corresponding light for both, I am sure the whole matter of education along the lines of pear blight control would be solved.

Treatment

The treatment for pear blight, or rather the methods for controlling it, may be divided into two classes, primary and secondary. The primary method of treating this disease consists of cutting out thoroughly and antiseptically the hold-over blight during the dormant season of the trees—that is, during the fall and winter. It has been explained that the hold-over blight may be found in the larger limbs, the trunk and even the root system. These hold-over cases have become such through the various means of infection pointed out, namely, through blossoms, buds or water-sprouts, which have become infected and through which the blight has gained entrance to the fleshy bark and cambium of the bodies and roots. The other methods of entrance are through growth cracks, crown galls, insect and bird punctures, or any other way by which the epidermis may be broken so as to expose the tissues beneath. It has also been shown that the pruning knife or other orchard instrument may be the means of spreading the disease. If the work of removing hold-over cases is done thoroughly it leaves no opportunity for additional advantages from any other secondary method.

Remember that the important thing is the removal of the source, or what will be the source of infection the following year. In the case of the pear or apple it is important that this work be done as skillfully as the work of a surgeon in removing a member infected with blood poison. Everyone realizes the attention given to the source of a city's

water supply, and it may be said that the death rate is very largely an index of its condition. In the same sense, the attention given the sanitary conditions of the orchards of any community is an index of the death rate of the orchards. Of course, the cutting out of hold-over blight must be done, not alone in a single orchard, but the work should be general and thorough throughout the entire area, such as an inclosed valley or even, for better work, an entire state. Complete eradication of pear blight from such a large area is, of course, very difficult. However, the fewer hold-over cases that may be missed will result in fewer cases of infection later in the spring and summer. As may be seen by referring to the factors influencing the disease, the presence of the germ is of primary importance. If the pear-blight germ is not present in the orchards there can be no blight, no matter what the weather conditions may be. The orchards of California existed for 25 years with varying climatic conditions, and no one ever heard of blight in those orchards until the germ was introduced.

The regular development of the disease has been pointed out by which it runs down on one side of the limb or body and not on the other; this often leads to failures in eradicating the blight from orchards. While the disease in the top is very easy to handle and anyone who looks at all closely can not only detect it but can readily remove the infected branches, the disease on the body and in the root system is not only hard to see, but is often difficult to find, especially on old trees where the crowns and bodies are covered with rough bark. It may be said here that the removal and the detection of hold-over in pear trees is not nearly so difficult as in the case of the apple and the quince. The Spitzenburg apple is probably the worst variety, if not the worst species of the pome family, in which to detect hold-over and to effectively remove it.

The gum exudate, when it is present, gives a clue to many otherwise obscure cases. However, in cases of late fall and summer infections, the lesions may be so small as to produce no exudate or give any other evidence of infection. A dead water-sprout or fruit spur, no matter how tiny it may be, leads to the detection of a case. Sometimes these have been broken off in cultivation or carelessly cut off without following up the infection at the base. Very often a water-sprout which has come up from the root system at some distance from the base of the tree becomes infected, and is later removed by cultivation; but the infection passes on up the infected root, finally involving the entire root system. Sometimes there is infection without a water-sprout or bud at all, and such cases are the hardest to detect unless some ooze has appeared. Such infections come about through insect punctures and growth cracks by means of which the germ has been introduced. Where there is a large amount of blight to be removed from the orchard, necessitating a great deal of labor, it has proven necessary in every case to go over the orchard critically, or perhaps we may say leisurely, on a dry, sunshiny day when there is good light, and find the few cases that have been missed on the first inspection. No matter how thorough the work, this careful method of inspection has proved extremely important. Not only should the work be inspected immediately following the general clean-up, but someone else with keen, well-trained eyes should look over the trees several times during the winter. A special effort should be made to find out when there is a new exudation. This may follow any warm, mild spell in the winter, when there is a wide range between the day and night temperature. Such conditions are known to affect the flow of sap in the sugar maple and other trees. A final inspection should be made just before blossoming time to catch any hold-over blight the last moment, in case it has been overlooked before.

After the blossoming period has passed so that the blight has had time to develop, if an area of blight infection is found in the orchard, careful examina-

tion of this will generally result in the finding of a case of hold-over blight in the center and from which all trouble may be traced. During the first year's work those who are just learning how to eradicate blight will probably miss a good many cases; however, after practice they usually become keener and rarely miss any. In fact, I have seen men who from the very first were able to do excellent work, but, like other jobs which require careful work and a sharp eye, relatively few men are capable of making first-class inspectors. In many of the large orchards where the question of efficient labor is serious and where all sorts of tramp and other low-class labor has been employed, absolute failures in blight control have generally resulted. As I have stated before, even the better sort of laborer cannot be thoroughly schooled in careful work of this kind within the space of a day or two. In every event, the best and most careful men should be placed in charge of work of this kind. It is a common mistake to think that the matter of eradication and control rests with the inspector alone. An inspector must have the co-operation of the entire district. I do not know of any one who would ask an inspector to assume the matter of cultivation, pruning or any other of the regular orchard practices; neither should an inspector be asked to do the actual work of blight eradication. The inspector is, in the first place, an instructor, and in the second place, the one to enforce the horticultural laws, but he is no common hired man.

No Spray Remedy

It must be understood from the very beginning that there is no spray cure or remedy for blight. It is a bacterial disease, and once the germ has gained entrance to the bark tissues and the cambium layer, by no means whatever can any external application in the way of a spray be effective. There is but one thing to do after infection has started, and that is to remove by cutting out the affected parts. In other words, the operation is purely surgical. In all of the cutting a strong disinfectant should be used to wipe off the tools after cutting into the blight as well as to wash off the wounds made by the instruments; otherwise, it is possible to introduce the germ into the cut surface and to carry it from tree to tree on the pruning tools. In the majority of cases in dry weather infection would not result from the use of pruning tools, even though they were not disinfected, but it is never a wise plan to take a chance. In the late summer or early fall when the exuberant growing season is over, the chances for infection by the use of unclean tools are not so great; however, it has been determined by numerous experiments that blight punctured into the fresh bark in the fall may remain semi-dormant through the winter and may result in a fine case of hold-over blight the following spring. In working out blight as much care should be used to prevent accidental inoculation and infection as a surgeon would use in performing a major operation.

Disinfection of Tools and Cuts

For disinfecting the cut surfaces and the instruments, the best thing to use is a solution of corrosive sublimate, or bichloride of mercury, in water, one part to one thousand. It is often advisable to use the disinfectant a little stronger, and there is no danger in using one to five hundred. Tablets may be obtained from any drug store, and the number to be used to produce any strength of solution is usually indicated upon the bottle. To be sure that no mistake is made, ask the druggist how many tablets to use to produce a solution of desired strength. When possible, use rain water, as the slightly alkaline waters in dry countries tend to precipitate the poisonous mercurial compound. Also use a glass or nonmetallic container, as a tin can or other metal container will react on the disinfectant and remove the poisonous principle. Corrosive sublimate kills the pear-blight germ in solutions in water when it is diluted to one part to 10,000; therefore, the above formulae are sufficiently strong and well within the limits. While

there are other disinfectants which may be used, bichloride of mercury is far the cheapest, and there is nothing gained by using anything else. The use of kerosene, gasoline and such like is certainly not permissible. Even carbolic acid is distinctly inferior to corrosive sublimate, and besides, its noxious smell and burning tendency do not warrant its use. It must be remembered, however, that corrosive sublimate is a deadly poison when taken internally, and the bottle or container should be plainly marked POISON. Applied externally to wounds, or upon the hands, it will cause no injury, but, on the other hand, will as readily disinfect, as in the case of the tools and cut limbs. The greatest care should be taken in emptying the bottles containing the solution when returning to the house, or otherwise keeping both the bottle and solution away from children or unsuspecting persons. As indicated before, there is no danger in getting the solution on the hands; in fact, a cut or wound may be treated with it to prevent bacterial infection which might result in blood poisoning. It should be understood, however, that the bacteria of pear blight are not pathogenic to man; that is to say, the germ can produce no evil effects even if introduced into the human system. It is a good plan to use a sponge, which, if fastened by a string about two feet in length and tied to one's clothing, is always handy when it is necessary to wipe the pruning tools and the cut surfaces of trees. Some operators tie the sponge by a very short string to the wrist, and this is probably the most convenient way to use it. An inch or three-quarter-inch carpenter's gouge is also an excellent tool in the makeup of a worker's outfit. With it a small chip may be taken out of the rough bark in inspecting large trees, and, besides, it is a very handy tool in working the blight out of difficult places where ordinary tools cannot be so easily used. In inspecting large trees, whether apple or pear, the gouge must be used to examine the bodies and the crowns. Unless this is done, cases of hold-over will certainly be missed. In large, rough-barked trees a chip should be taken out at intervals of about two inches all around the crown, as well as higher up on the body. It is not necessary to go below the outer layer of soft bark tissue, and it is quite unnecessary to cut as far as the wood. When the chip is taken out, if the bark tissue presents a water-soaked appearance, or if it is of a red or perhaps bright red color, it is almost certain that the body is infected. When a point of infection is found, it should be followed up so as to determine the extent to which the infection has run. If careful work of this kind is done, no hold-over will escape detection.

It is a good plan when ignorant pruners are in the orchard to make them disinfect in the general pruning. As a rule, I would suggest that eradication of blight precede the general pruning. A special set of skilled help should do this work, then the ordinary pruner may follow. Even in ordinary pruning it is a safe plan to disinfect when leaving each tree in order to avoid carrying the disease in case the pruner has cut into an overlooked case of the blight. There is a question as to what to do when the blight is found running down the bodies and into the roots of the trees. Where the disease occurs on limbs it can be readily sawed off, as the removal of even the greater portion of the twigs and the branches by no means entirely destroys the value of the tree. The tree will push its new top vigorously and in two or three years be in full bearing again. Where the blight has run past the main forks, however, a serious question is involved. Where inefficient, unskilled labor has to be used we advise pulling out all trees where it has run down the bodies, or has infected the root system. Many growers, when the matter is explained to them, condemn such trees and root them out, and thus, of course, simplify the matter. On the other hand, it is possible to effect an eradication of the blight by carefully cutting out the bark, and even the discolored wood, entirely beyond the limits of the infection. An

inch or two at the side and three to six inches at the bottom and top of the infection may be regarded as safe if done during the winter. However, such cutting will not do during the spring or summer when the sap is flowing rapidly. Such work invariably results in missing many cases. It is never a good plan to leave the matter of working out hold-over blight until after the sap begins to flow. The best time to do this successfully is during the dormant period. However, I do not mean to say that hold-over may not be removed at any time, but I do mean to say the chances for a successful operation are very much less, and the amount of cutting necessary is always much greater and more destructive to the appearance and health of the tree. As a general principle, we believe in drawing the line on those cases where the blight has gone below the crown and into the root system. Even here, however, it is possible to dig away the soil and follow up the blight on the roots. A tree should never be considered as wholly lost where skilled labor may be had, and where the body is not completely girdled or where the root system is not too badly involved. Where a large portion of the bark must be removed from the body, leaving only a small portion to carry sap, bridge grafting may be resorted to, to fill in the part cut away. If this is well done, and if the bared wood has been protected by a white lead paint, a new bark covering may be grown. This has been done in a very successful way in many instances. In case the tree has set a heavy crop of buds for the next year, this plan will eventually help to carry the fruit crop.

Seven-year old Comice Pear Tree Girdled by Blight in 1908. Bridge grafted spring of 1909; photographed fall of 1910. The bridge grafts saved the tree, which has borne a heavy crop of fruit each year since the blight was eradicated and the tree bridged. (Original.)

Comice Pear Tree Showing a Bad Case of Body Blight which has been cut out. Note the bridge graft, about two feet long, which connects the healthy tissue above and below the limits of infection. Additional grafts were put in after photograph was taken and these have united laterally so as to form a complete cover of new bark. (Original.)

Bridge Grafting

In case a part of the root system, as well as the bark and cambium above, must be removed, the parts removed may be eventually filled in by planting good

young trees from the nursery row, setting the roots well down and grafting them into the healthy tissues above. These trees will tend to grow together and finally fill in the portion cut away. Care must be taken, however, that the thrifty sprouts from these young trees do not become affected with blight.

Summer Cutting

Summer cutting intelligently applied may do a great deal of good in saving trees which would otherwise be lost. This is especially advisable where there is only a little blight in the orchard (by this I mean to say that unless the infection is so serious as to necessitate the destruction of the entire tree), and it should always be practiced. The dry summer weather of most of the Pacific coast country, especially from Southern Oregon southward, is certainly not favorable for new infections, but occasionally spring rains occur rather late, and sometimes extend into the summer and after the blossoming time. Under Eastern conditions, or where excessive spring and summer rains are the rule, summer cutting is only half successful, and has, therefore, been condemned by most pear and apple orchardists as a failure. Summer cutting is a failure, or is made apparently so because of the fact that new infections, invisible at the time the work is done, may develop in a few days so that a week after the most thorough cutting out of the blight a new crop of infection is found thriving. Another source of difficulty in the spring or summertime arises from the rapid extension of the blight infection in the branches of varieties that are very susceptible to the disease. Sometimes, especially where the infection has reached a large leader or the body, the germs may often be found a foot or two beyond the discoloration, as the disease is spreading so rapidly that the bark has not had time to discolor sufficiently to be detected; therefore, in summer cutting the removal of the infection must be at a greater distance from the point of infection than in fall and winter work. Experienced men can judge somewhat of the distance by the rapidity with which the stained bark blends off into the normal bark. Furthermore, a reddish streak will often be apparent in the cambium and young wood, and by following it up a clue may be had as to the possible trend of the blight. The greater the distance in which the blending takes place the lower the cut must be made, and conversely. Disinfection is more important in summer cutting than in winter cutting, and, although in the dry Coast climate the sunlight and dry atmosphere will usually take care of most of the germs accidentally left on cut surfaces, it is by no means true that infection may not take place from such cases. Furthermore, a foggy morning following the cutting might spoil the whole procedure, so the only safe way is to always disinfect. Often in using the tools, accidental cuts or punctures are made, and it may happen that infection may be produced by them. The work of summer cutting of blight should be done with as great care as possible; if this is not done one may reasonably expect to do it all over again, and, perhaps, lose some very valuable trees.

Experience on the Pacific coast shows that such varieties as the Spitzenburg apple, the Bartlett, Howell, Easter, Bosc and Comice pears are very susceptible, and at no time should one disregard the removal of a fruit spur or a twig which is found to be infected with blight. During the past eight years on the Pacific coast it has been my experience that thousands of trees have been saved by the prompt removal of infected twigs and fruit spurs.

Never remove an infected spur by breaking it off. First find the limits of the infection and then remove the spur with a knife. I have in mind a particular case in which the advice "to break off the infected spurs" nearly ruined an orchard.

By far the greater part, probably as high as 80 per cent, of the loss of pear trees in California and Southern Oregon has resulted from body and root infec-

tions through water-sprouts and low fruit spurs. Water-sprouts coming up from the root system, even at some distance from the base of the tree, have caused fatal infections. Fruit spurs, when located on the body or main forks and becoming infected, soon introduce the germs into the thick, fleshy bark, which carries much of the sap, and destruction is very rapid if the tree is growing rapidly and if it happens to be a very susceptible variety. Water-sprouts from the French stocks on which the majority of our commercial varieties are grafted are very susceptible and should be removed with the greatest care. It needs no argument, therefore, to state that the removal of water-sprouts and fruit spurs well up on the limbs is an important subsidiary practice in the control of pear blight. Much of the cutting of water-sprouts is done by farm hands, who remove them so as to leave a stub an inch or so long. The result is that several water-sprouts come from the same place the next year. Water-sprouts should always be cut out as far in as the wood, and a gouge or sharp saw, although producing a larger cut surface, effectually removes the spur for all time. Heavy pruning back of the tops of the trees, as generally practiced throughout the Coast as a means to secure heavy fruit yields, encourages the pushing of these water-sprouts so that the problem is really an important one.

Crown galls, which may be found on any part of the root system or the body and branches of a tree, should always be removed when found. The Spitzenburg is very susceptible to crown gall, and it is not infrequent to find numerous galls on the body and limbs. The peculiar nature of these crown galls is such that pear-blight germs find a ready entrance. I have seen hundreds of infections which entered the trees through crown galls. In cutting away crown galls, which in themselves are caused by a bacterial organism, the bark and cambium should be peeled away at least an inch from the edge of the gall, and the gall itself completely cut out with a chisel or gouge. Then thoroughly sterilize the exposed surface. The reason for going well beyond the outer margin of the gall in removing it is because we find the organisms causing the crown gall in greatest numbers along this margin.

Resistant Stocks

One matter of very great importance, and which has been mentioned before, is the possibility of working all the non-resistant varieties of pears and apples on resistant stocks or bodies. It has been stated that the Winter Nelis and the Kieffer varieties of pears are the most resistant of commercial varieties. Under Eastern and Southern conditions the Kieffer pear is really the only one that has stood against the ravages of the blight. By this I do not mean to say that it is wholly immune, because under extreme conditions it will blight. However, the conditions on the Pacific coast are such that if the Kieffer were used as a stock or body there would be little danger of losing the tree by root and body infections. Experience in California has shown that while Bartlett and

Crown Gall on Branch of Spitzenburg Apple showing pear blight infection. Note the ooze coming out both sides of the crown gall. (Original.)

other non-resistant varieties have blighted as far as the Nelis and Kieffer stocks, the infections have usually stopped at the graft union. Every pear grower on the Coast who has had experience with blight knows that Winter Nelis and Kieffer, the latter being very rarely grown, seldom blight seriously, although they may be surrounded by a great deal of infection. Of course, we do know, on the other hand, that they are not immune even on the Coast. I could offer as a suggestion that Kieffer stocks might well be set out and afterwards top-grafted to any of the commercial varieties of pears. This will, at least, provide resistant bodies and roots which will eliminate the danger of loss by body and root infection. I wish to urge that the finding of a variety of pear entirely immune to pear blight will alone solve the pear-blight problem for this species of pome fruit. The same will be true of any other of the pome fruits. As soon as an immune is found the possibilities of plant breeding will, no doubt, evolve commercial varieties equal to those that we have now, and, at the same time, they will be immune from disease. This is looking far into the future, but it will be done as it has been done with other plants.

Eradication of Blight

Some remarkable cases of eradication have been attempted and successfully accomplished in California and Oregon orchards, notably in the vicinity of Vacaville, California, and in the upper Rogue River valley in Oregon. In some cases where perhaps 50 per cent of the trees were infected on the bodies and in the roots, but still had sufficient living bark and a few roots left, the diseased portions were completely cut out, even to the removal of all of the roots on one side of the tree and peeling fully three-fourths of the bark from the body. I have noted in some instances where fully three dollars in labor was expended in removing the blight from a single tree. This, of course, is exceptional, but where the value of the tree may be placed at from ten to fifty dollars, depending upon its ability to bear heavy crops of fruit, this would not seem to be an undue expenditure in eradicating the blight and saving the tree. Many of the trees so treated have not lost their vigor and are still bearing good crops of fruit. From the standpoint of the pathologist, if the pear blight is completely removed under antiseptic methods from the body and roots, the job is satisfactory. It remains, therefore, with the grower to decide how much labor he is going to undertake to save the tree. Experience throughout the East and South has been that where much work of this sort has been attempted on the bodies, numerous failures have resulted, and the work rendered worse than useless. There is also more or less danger, in such cases, of the blight in the sap wood. While the germ almost wholly lives in the bark and cambium, it is also known that it may infect the rich sap wood of the Bartlett, Howell and other varieties of pears. This is also true of the Spitzenburg apple. Occasionally it has been noted that the germs spread out in the vessels of the wood and live on the starch and sugar stored there. It is, therefore, desirable to let all eradication work on the bodies dry out thoroughly for perhaps a month or so before painting over the wound with white-lead paint. If any growth of disease takes place the ooze may be detected by the discoloration appearing on the paint. It is certain that a great deal of blight eradication work may be done to the best advantage in the early autumn, for certainly better results may be obtained before the fall rains begin. It is also much easier to detect the blight which has attacked the branches and twigs during the summer, because at this time the foliage generally shows where the blight has been working. Besides, trees that have the roots infected usually begin to show a reddish discoloration in the foliage. A bad body or limb infection will also have a tendency to cause the same discoloration in the foliage above the infected part. However, this reddish discoloration of the foliage is by no means a certain indication of blight

infection, as there are many other causes which would produce a like appearance in the foliage. Root rot, borers, gophers or even a girdle caused by any means whatever, will produce practically the same discoloration. In irrigated orchards where the water has been cut off too early in the summer, there is always a tendency toward foliage discoloration. The foliage test, however, is a sure one that something is wrong with the tree, and such a tree should never be passed by without making a very critical examination. Careless inspection and careless eradication are really worse than no work at all, for on the one hand enough work may be done to deceive, while on the other hand the chance for infection and subsequent spread of the disease remains.

Popular Remedies

Spraying, as a rule, is of little use in controlling the blight. In the blooming season new blossoms are opening every hour of the day and new shoots are pushing forth, all of which are subject to infection through insect agencies. From the standpoint, therefore, of attacking the pear-blight problem by spraying, there is nothing to be done so far as the blossoms and young shoots are concerned. On the other hand, we have been able to cover up some mild cases by whitewash, applied thickly, so that they were unable, temporarily, to be a source of infection during the blossoming season. Whitewashing or spraying in the winter time may be of some slight assistance in the matter, but it is not recommended. A strong lime-sulphur wash applied to the bodies just before the blossoms open will have a tendency to keep insects away from any infection which would ooze. It must be understood, however, that all pear blight infection should be carefully removed, and in no case should there be any attempt to cover up any known case of hold-over blight. The only reason for advocating the strong lime-sulphur wash is that, should a case be missed by accident, the use of the wash may prevent the infection from getting away. Just as soon as it is discovered, whether the wash has been applied or not, it should be removed. I wish to emphasize that any attempt to spray or wash may be considered only a temporary makeshift. If there is a case of hold-over that has been covered by spray or wash, it must be eventually removed, and especially so if it is in the body of the tree. The wash in no way controls the spread of the blight in the soft bark beneath; its only office is to prevent, if possible, the spread of blight to other trees, by preventing insects from coming into contact with the bacterial ooze.

There are on the market a number of so-called remedies for pear blight. All of the concerns selling these remedies have no standing whatever, and their literature, which is sent broadcast over the country, may well be promptly thrown in the fire. A favorite remedy is a mixture of potassium cyanide and sulphur placed about the roots of the tree. Still others consist of such insolubles as charcoal, calomel, sulphur, bone black and other substances put into holes bored into the bodies of the trees. In every community trees may be found that have been treated in this way, and invariably the material put into the holes has neither changed its chemical makeup nor has it diminished in quantity by absorption.

A common remedy is the use of table salt, or even some alkali. The use of table salt is merely to inhibit the growth of the tree by preventing the normal taking up of water by the root system. A tree grown in a very saline soil cannot take up water enough to make a strong growth, hence it does not blight badly; perhaps not at all. There should be no desire on the part of an orchardist to injure his soil, and consequently his trees, by adding to the soil any chemical or salt known to have a poisonous action, or, at least, an inhibitive effect. Do not take the word of everyone or anyone who has something to sell. Before buying any cure or remedy, consult some one who can be trusted and who has nothing for sale.

Wrong Form of Pear Tree. The central leader renders it difficult to eradicate or control blight. The open head is the proper type of tree. (Original.)

Proper Shape of Tree

The whole subject of pruning is such a lengthy one that it can scarcely be gone into in full detail. However, the vase-formed tree, headed low and with the main branches shortened in to 18 inches or less, is decidedly the most desirable form to grow a tree. Up to the third year the main forks or leaders should be shortened in so as to make a tree with sturdy framework, and at the same time keep it down low so as to be accessible for spraying, picking fruit, etc. If the water-sprouts are kept off the body and main limbs, and if lateral fruit branches are developed within the fruiting area, the most desirable form of tree will be produced for controlling the blight. A tree pruned to this form, even if infected, has its blossoms well away from the vulnerable parts of the tree, namely, the body and framework. The tall pyramid, with a single main leader and with its long branches covered with fruit spurs and water-sprouts, makes the work of fighting pear blight a difficult one. It is hard to get into the top of the tree with this closed center to find out what is going on, and, besides, the fruit spurs and water-sprouts being close to the body as well as upon it, readily carry the blight in, usually resulting in the entire loss of the main portion, if not the entire tree. One only need look around where the pyramidal or central-leader type is grown, and it will be seen that an infection on the body resulting in a girdling of it necessitates the removal of the entire center above the point of infection; thus removing practically the heart of the tree's growth. Any of the limbs left below the point of infection are usually long and slender, and, besides, are usually poorly placed to form a good tree of any sort thereafter. The prevailing type of Bartlett tree in California is very near the desirable form; however, in many cases, after heading back the trees, they are allowed to grow three or four years and then reheaded several feet from the crown, sometimes as high as 15 feet, resulting in a two-story pear tree. In very few cases has there been any attempt to keep the fruit off the main framework branches, and to keep the water-sprouts and fruit spurs from the bodies and roots. There has been no special occasion for forking at the framework, since at the time the trees were being formed pear blight had not made its entrance into the California orchards. Among many growers, especially those of the old school, we find that there is a tendency to adhere to the pyramid form of tree in practically all varieties grown, even the Bartlett. We readily understand why this has been the case, because the pioneer fruit growers recognized this form of tree as being, perhaps, the easiest to prune and undoubtedly the easiest to keep from breaking down when heavily loaded with fruit. Their weak attempts at forming the open-headed tree were failures because during the first two or three years of growth they neglected to shorten it enough. Even today this is the common error; it

The Result of Growing a Tree with the Central Leader. Blight infection made it necessary to remove practically the entire bearing area of the tree. The limbs left are too long and weak. (Original.)

would be better to shorten to six inches than to lengthen to 18 inches. Now that pear blight has come this method of pruning or forming the tree by maintaining a central leader will have to be altered. I know of perhaps five or six hundred trees that have been wholly lost on account of this style of growth; that is to say, practically the entire bearing portion of the trees had to be taken out on account of blight girdling the leader. In many young orchards which have been planted within the past two or three years, the growers are changing them into the vase or open-head form, recognizing the great difficulty in saving the other type of tree should blight become serious. In the larger trees it is a rather difficult thing to change them over into the vase form, but in every case where blight has seriously damaged such trees the resultant tree, of necessity, becomes vase-formed when the blight is cut out.

Severe pruning, though in most cases, of course, giving good results in stimulating vigorous twig growth and fruit production, tends also to result in more serious attacks of the blight. Everyone knows that the more vigorous the winter pruning the more luxuriant the twig growth during the following season. The result always is that every dormant bud tends to push, and, being very tender and sappy, easily becomes infected and blights badly. On the other hand, as soon as the trees come into bearing, summer pruning, if practiced in the proper way, will result in a more normal vegetative condition, and the tendency to set fruit will also be correspondingly greater. A heavy set of fruit, other factors being equal, will always tend to keep down excessive vigor; and this is usually a good thing under Pacific coast conditions, where the growing season is quite long as compared with conditions in the eastern sections of the United States.

Cultivation, Fertilization and Irrigation

Cultivation, fertilization and irrigation are three very important factors to be considered in connection with the control of pear blight. I shall take these up separately, with only as much detail as will make the text plain. Thorough cultivation is more essential, especially from Southern Oregon southward on the Pacific coast, than in the East, for the reason that rainfall is not only much less but from the spring of the year until autumn the season is practically without precipitation. In districts where irrigation is practiced, cultivation is just as necessary. In the East it is not an uncommon practice to permit pear and apple orchards to grow in sod when it is evident that the blight is getting beyond control. Everyone knows that lack of cultivation induces surface evaporation from the soil, and trees are thus made to grow more slowly because of lack of moisture, and hence, even very susceptible varieties of pears and apples do not blight badly, because the vegetative vigor is lacking. The necessity for cultivation, as well as the method to be used, varies so greatly in the Pacific coast orchards that it is impossible to make any general rule. Each soil type requires different treatment, to the end

that soil moisture be retained during the growing season of the trees. Some of the moist, deep soils in the Sacramento river districts, and perhaps in a few spots in the Rogue River valley, retain their moisture so well that pears get along very well for a year or so without cultivation. On the other hand, practically all of the lands in these districts need thorough cultivation to bring them up to anything like normal and to mature full crops.

The matter of fertilization is an important one, especially where large crops have been taken for several successive years from an orchard. However, it is known that nitrogenous fertilizers, such as stable manure, as well as commercial fertilizers containing large amounts of readily available nitrates, tend to produce luxuriant growth, and hence, trees so stimulated blight more seriously than those not fertilized. Fertilizer must be used, but it should be used in moderate amounts. There is no advantage in using an excess of potash to make the trees more hardy and thus more resistant to blight. The fondest hopes of some would-be experimenters have been blasted by trying to prevent blight injury through the use of potash in the form of muriate and sulphate. It is the same old story, the blight must be controlled by having no hold-overs present during the infection period. I have seen large commercial orchards practically ruined in one year where potash was used as a preventive against blight; so avoid using it for any other purpose than adding fertility to the soil.

The whole subject of irrigation is so broad that it will only be discussed here in its connection with the control and eradication of pear blight. While irrigation cannot be considered in the same light as rainfall, since it is merely water applied to the root system, it is, nevertheless, important to understand it thoroughly, especially in connection with blight control. It has been pointed out that periods of rainy weather during the spring and summer produce what has been termed infection periods, through the wetting of the trees, and thus permitting a spread of the infection through infected trees and making it possible for the germs to be more readily distributed over a considerable area in any district. The warm, muggy weather, such as we find common in the East following rainy periods, further tends to influence the spread of infection. Irrigation in no way induces any of the above conditions, but, on the other hand, its effect is noted in the tendency of the trees to push very rapidly under a normal water supply, and to become sappy and less resistant to blight. It is well, therefore, to have this in mind, and to apply no more water than is actually necessary for the production of the crop or the maintaining of a healthy condition in the tree. In cases where a serious infection has made itself apparent, the water should be immediately turned off and kept off until the blight is under control.

It is safe to say that in all irrigated districts some harm usually results from over-irrigation rather than under-irrigation. The tendency to apply too much water is especially the great fault with beginners in irrigation. To irrigate properly and scientifically one should know soil conditions, soil depths and drainage. Another important factor is a knowledge of the duty of water; by this it is to be understood the amount of water which should be used to produce the best results. It is well known that the destruction of the pears by blight in the San Joaquin valley, in California, was due as much to maintaining too vigorous a growth by irrigation as it was through lack of the important detail knowledge of fighting it scientifically. Not only were the orchards lost, but valuable soils were practically ruined by over-irrigation.

In the Eastern states it is a very common practice to sow a crop of cow peas, sorghum, or sometimes even Indian corn in the late spring. This is done to take up the surplus moisture of the soil from the trees, and has a tendency to check luxuriant growth, and hence acts to check pear blight. It must be under-

stood, however, that the above practice would not be at all advisable in most Pacific coast districts, where there is a shortage of soil moisture. There are localities, however, where it may on some occasions become necessary to make use of cover crops in this way. The use of cover crops on the Pacific coast should be for a wholly different purpose, namely, to add fertility to the soil as well as to change its physical condition; in fact, the use of cover crops may be considered to serve the same purpose as stable manure in making the soil more easily tilled and rendering it in better condition for giving up plant food. Cover crops of vetch or field peas, of course, add nitrogen to the soil, and, from this standpoint, it is perhaps better that these leguminous plants should be used in preference to rye, or any of the grains or grasses. On some soils such cover crops as rye or wheat do not give the best results, especially on the sticky soils. It usually takes a great deal of labor to produce a good soil mulch after turning under a crop of rye.

The rule in the pear orchards of the Eastern states has been to keep the trees in a half-starved condition for fear blight would destroy them. Orchard treatment of this kind naturally renders the fruit less luscious and with a distinctly poorer flavor than fruit grown under good cultivation. While I would advise a good deal of caution in producing a too vigorous or sappy tree, when there is serious danger of destruction by blight, I would not advise the pear and apple growers of the Pacific coast to starve or under-cultivate or under-prune their trees; but I do mean to say that they should practice moderation in all these things. This is especially true in districts where the blight is new to them, and where they are not thoroughly acquainted with the methods of eradicating it from their orchards and keeping it under control. Pear blight is so different from all other orchard diseases, which respond so readily to spray treatments, that it has been the general rule for whole communities, and even states, to lose all their orchards before being brought to a realization of the necessity for studying the disease carefully and obeying to the letter the instructions for combating it.

Losses from Blight

Mention has been made of the enormous losses in the pear districts of the San Joaquin valley, California. In the short space of three years, from 1900 to 1904, almost half a million pear trees were lost by blight. Practically no attempt was made to check the disease, and one of the greatest industries of the San Joaquin valley vanished like a dream, even before the people realized what had befallen them. As in other localities, east and south, the growers had a self-sufficient and self-satisfied feeling that blight could never hurt them. They had grown pears for a quarter of a century and more, and such a thing as blight entering their valley was just as impossible as anything one might imagine.

In all that time, thunder, lightning, excessive heat, cold, etc., had caused not the slightest injury. However, as soon as blight came, all the factors mentioned above seemed to explain their predicament fully; they needed no help and spurned assistance. This is the story, in a few words, a story which might be told of many other localities which had suffered the same calamity.

In 1904 the blight invaded the pear district of the Sacramento valley, and although some little work was done in the matter of eradicating it, the efforts were weak and ineffective. Prominent men in the state became alarmed and the pathologists of the United States Department of Agriculture were called to the Coast. In the fall of 1904 Professor M. B. Waite made his first visit to California and inaugurated a plan of campaign for eradicating it, or at least keeping it under control. The Government pathologists did not come to the Pacific coast until they were called. Such influential men as Ex-Governor Pardee and prominent Southern Pacific officials ap-

pealed to Hon. James Wilson, then Secretary of Agriculture, to send as many men as he had available, to aid in what was thought to be almost a hopeless case. Blight was everywhere, with the exception of the Santa Clara valley, which to this day has kept it out by very careful work. The task undertaken was an enormous one, and the amount of territory necessary to be covered was so large that every available source of help was called for, and the campaign finally started in the early winter of 1905. The time was short, but good work was done. In many districts where there was a willingness to co-operate with the Government officers the blight was checked; in others, where conditions were the reverse, the blight gained headway. The result of several years' work, which has been carried on up to the present time by the United States Department of Agriculture, is that several districts in the Sacramento valley and adjacent valleys have saved their pears. There are particular instances where practically everything went excepting single orchards which were saved by individual growers, by using heroic measures and carrying into effect every detail given them by the Government officers. To this day these men continue to grow pears, while their neighbors are entirely out of the business. They are charged with being lucky, but there is no luck in fighting pear blight; it is careful attention to details and constant watchfulness.

In the foothill districts of Eldorado, Placer and Nevada counties, to the east of Sacramento, the loss has been exceedingly light. The growers in these sections began their fight at an early stage and have kept it up unceasingly, so that at this time there are probably no fewer bearing pear trees than there were years ago.

It would be very difficult to tell how many trees were lost in California throughout the entire state, but the figures taken from the carload shipments will tell the story pretty well. In 1900 California shipped 2,115 carloads of pears, and in the same year 7,275 tons were dried, and perhaps half a million cases were canned. In 1907 only 1,039 cars were shipped and only 500 tons were dried. We have no data on the canned product, but it is well known that it fell off correspondingly. Such figures should strike terror into any community whose industry is that of growing pears and apples.

Importance of Pathological Work

The importance of the pear blight problem to the horticultural interests of the Pacific Coast states emphasizes very clearly the value and necessity of plant pathological work. What each district needs is a strong man, who is both scientific and practical, for handling such a difficult problem. Not only does each district need the constant and careful attention of a trained pathologist, but it needs inspectors and commissioners who will see to it that the horticultural statutes are rigidly enforced. If a grower chooses to lose his crop by any disease which is not considered contagious or spreading, and which may readily be controlled by simple spray treatments, it is his own lookout; but where his pears and apples are a source of general infection from pear blight it becomes a matter for the district commissioner and local inspector. There is only one remedy, and that is to increase the inspection and to make it rigid. Perhaps one other thing might be added. It would be a wise plan for each county or district to appoint a large number of volunteer inspectors who would serve without pay in their own interest, but who would be vested with authority to inspect and condemn within their immediate neighborhood.

Factors in the Control of Pear Blight

During the season of 1913 pear blight was more severe in many districts on the Pacific coast than it had been for several years previous. In many sections the infection was such as to cause a great deal of loss, and generally the disease was in the form of a severe epidemic. The question is often asked, "Why do we have epidemics of pear blight." This question

is no more difficult to answer than the question, "Why do we have enormous yields of fruit or harvests of grain?" The answer to the question as to why we have more bountiful crops one year than another is usually given by the average man in a single sentence, "The conditions were more favorable." In other words, the reason why we have occasional phenomenal yields is because the conditions for plant growth were unusually good.

For our heavy crop of wheat we sowed the seed at the right time and in the proper amount, the soil had been previously well prepared, climatic conditions during the entire season were favorable, and, more than likely, we used good judgment in taking advantage of nature.

It must be remembered that the pear-blight germ is a plant which depends upon favorable conditions for its best development; it must be "planted" on the right soils and the conditions for its maximum growth must be favorable, as in the case of the wheat plant. While it is known that disease-producing bacteria may be more virulent at one time than another, just as seeds may be more or less viable, nevertheless the conditions for a disease-producing organism's development must be favorable or it will not develop so as to cause what is called an "epidemic." After all, an epidemic of pear blight may be compared with an "epidemic of good wheat crops."

It must be remembered that a plant will not make its best growth where conditions are below normal. Change these conditions for the better and maximum growth or development of the plant is the result. Those who have lived in the arid Middle West have probably noted that if the dry prairie is broken up and allowed to lie without cultivation the following season a magnificent crop of sunflowers will be the result. Where did these sunflowers come from? They certainly were not carried there by birds or wind in the amount necessary to produce such a heavy crop. The sunflower plants were there before the land was plowed, but no one but a botanist would have known them to be sunflowers. Instead of being the rather tall, yellow-flowered plants which everyone knows, they were merely minute, few-leaved specimens, and instead of bearing the large golden-yellow flowers, these dwarfed sunflower plants produced but a single flower, each having but one small ray and but a single seed. However, when the land was broken the conditions for plant growth were improved and the seeds from the dwarfed sunflower plants instead of producing dwarfs produced vigorous plants. The "epidemic" of sunflowers was produced simply by making conditions favorable. The seed was planted deeper and soil moisture was conserved. This example of what the sunflower will do under various conditions will illustrate the point I wish to make, namely, that the pear-blight germ, being a plant, must be influenced by environment and change of conditions.

Cause of Serious Infection

In order to have a serious pear-blight epidemic the following conditions are necessary: (1) The germ must be present; (2) insect or other agencies for the "sowing" or spread of the blight organism must be plentiful and active; (3) conditions for the best development of the germ after it has been "planted" must be favorable. It is easily seen that there can be no infection if the blight germ is not present, and, furthermore, there can be no epidemic even though the blight germ be present providing the other factors are wanting. Those who have had experience with pear blight know that it will attack all species of the pome family, and that any part of the tree may become infected—blossom, twig, limb, body, crown or root.

Such expressions as "blossom blight," "twig blight," "body blight," "collar-rot phase," "root blight," "fire blight," etc., are all in a measure misleading, as fruit growers are often mistaken in thinking that these terms indicate a different disease in each case. The term "fire blight" is not good for the reason that fire-scorched trees do not resemble trees badly blighted by the blight germ. Furthermore, serious infection which may result in the death of the tree may not show

any indication of the so-called "fire blight." This is true in serious crown and root infection.

The term "collar-rot phase" is a notably bad one, simply because the germ does not produce a rot. The germ causing pear blight does not belong to the rot-producing group of plant parasites. Even the term "pear blight" is not a good one; it would be best to make use of the term "pome blight," or better, "bacterial pome blight." There are certain other diseases of pome fruits which often produce effects somewhat resembling the bacterial blight, and therefore it would be much better in speaking of blight to qualify it. If we would use the term "bacterial blight" in the case of pears, apples, quinces and other pome fruits we would not fall into error.

As stated above, in order to have a general infection, or for that matter any infection, the blight germ must be present. It has been demonstrated that this germ will live during the dormant season of the tree in the cankers formed by the previous year's infection of limbs, bodies or roots of pome trees. No part of a pome fruit tree may be free from infection. The germ is carried from these centers called "hold-overs" by various agencies, principally insects. However, birds and other animals, even man himself, may be distributing agents.

For a good many years, besides having charge of eradication work, the writer has done much investigation work in determining the relation of various carriers of infection to blight epidemics. A very large number of species of insects and their near relatives have been studied. Not only flying insects have been found to be effective in spreading infection, but also many insects and insect-like species which do not depend upon flight have been found particularly dangerous. In this short article we cannot discuss the various insect agencies; however, it is enough to say that insects and their near relatives are the most important factors in the distribution of the germ of blight.

Upon the control of blight, therefore, depends in a great measure the control of insects. However, in the first place all sources of infection, namely, the hold-over cankers, should be carefully eradicated. This is a difficult thing to do, for the reason that the most careful worker will often miss hold-over blight. We know that there are varieties of pome fruits which are very susceptible to the disease; others that are quite resistant. We often hear of varieties being "immune," but, so far, no species of the pome family has been found immune to blight. There are various degrees of resistance, and that is about all that can be said. Very often the attention of the fruit grower is directed away from resistant varieties by the statement that they are so resistant that blight will not hold over in them.

However, every fruit grower knows that our cultivated varieties are not growing on their own roots. For instance, a Bartlett pear is not all Bartlett; a Newtown apple is not all Newtown, and so on. Until recently no attention was paid by the nurserymen to blight-resistant stock upon which to work our commercial varieties. In the main, our commercial varieties of pears are all worked on French stock which is very susceptible to blight. Our apples are also worked on seedling stock which is never selected for resistance. From this it can be readily seen that, although the variety top-worked on the stock may be quite resistant, the stock or root being very susceptible renders the tree unsafe.

It is often said that a chain is no stronger than its weakest link, and, in the same way, a variety is no more resistant than its least resistant part. If the root system is very susceptible, the tree may be lost although apparently there may have been no infection noted above the ground. I have seen the worst cases of blossom and twig infection in very resistant varieties where not a single hold-over could be found in the orchard itself, or in the immediate vicinity, so far as the examination of the parts above the ground was concerned. However, by noting the infection centers, examination

of the crowns and roots below the ground showed the presence of hold-over blight in certain trees.

In the case of the Newtowns, which are quite resistant under average conditions, I have found the most serious holdovers in the roots (stock). Here, then, is an important factor in the control of blight. Not only should the part above the ground be examined, but the crown and roots of a tree should be bared so as to be sure that no hold-over exists there. There is no mystery about crown and root infection; certain insect agencies work as readily under ground as they do above. Furthermore, in cases of severe blossom, twig or limb infection, infection may be carried down to the roots from above by rain. I have been able to demonstrate the presence of blight germs in droplets of rain-water trickling down the trunks of trees.

For many years I have advised the use of sticky bands in the control of insects which are known as blight carriers. In this connection it may be said that water-sprouts are not necessarily the only entrance points for root infection. Of course many root infections may be traced directly to infected water-sprouts coming from the crown and roots, but many infections are brought about by direct crown and root infection. The entrance directly into the crown and root is usually effected through growth cracks and by means of punctures made by eating, boring and sucking insects carrying the germs. Such insects may be caught by the use of sticky bands. Aphides should also be kept under good control, as they are notable carriers of infection to the succulent growths.

Tree medication has always been a favorite hobby with many people. Theoretically, there may be some basis for work of this kind, but the practice of controlling blight by the use of the hypodermic needle has proven unsatisfactory. In my investigation work covering a long period of years, I have used all sorts of chemicals and chemical combinations both externally and hypodermically, but so far no promising results have been forthcoming. It is said that a drowning man will grasp at a straw; we have grasped at everything, whether it showed promise or not.

The work of pear blight control must depend, at least for the present, upon the methods which have been worked out, namely, careful eradication of hold-over blight, thorough disinfection, and last, but not least, the control of insect agencies. Of course, certain insects, such as bees, are necessary for pollination, but the time over which they work is very short as compared with the growing season following the blossoming period, and during which period the most serious infections are produced. During the growing season, blight should be removed whenever it appears; any living infection should always be considered a center for further spread of infection.

In future planting we should demand at least resistant roots for our commercial varieties of apples and pears. Already many nurserymen are growing commercial varieties worked on resistant roots, and many have even gone so far as to grow resistant varieties for top-working. The control of blight is not so difficult when the framework, body and roots are all resistant to blight to the extent that hold-overs will rarely occur in them.

The development of commercial varieties equal to our well-known varieties and at the same time resistant to blight is an ideal we have been striving toward for many years. Many European-Oriental hybrids of considerable resistance have been produced, but their quality does not compare with our well-known commercial varieties. Breeding and selection will in time solve the question of blight control, but for the present we must adopt the best practice known to save the pear and apple orchards now growing. Experimentation should go on, but in a dangerously infectious disease, such as pear blight is, all experimentation should be taken out of the hands of the amateur. Much of our trouble in the control of this infectious disease is due to a desire to experiment on the part of those wholly unfit for work of this kind.

The man who knows nothing about bacteriology would hardly consider himself safe in experimenting with the anthrax germ; neither should he consider himself capable of experimenting with the pear-blight germ.

Summary

To those who have read the preceding carefully, it may seem unnecessary to add anything more, as it is believed that all of the important facts about pear blight have been clearly stated. However, a resume will bring before us all the pertinent facts so that the reader may see at a glance what he may want to know without reading the text again.

1. The history of pear blight dates from the year 1780; the first record was published in 1794 in the transactions of the Massachusetts Society for the Promotion of Agriculture. This first paper on pear blight gave to the highlands of the upper Hudson the distinction of being the birthplace of the disease. However, at the time of the discovery, the disease had a wider spread throughout the New England states than has been recorded.

2. The disease known as pear blight, although of North American origin, has found a foothold in Europe.

3. The true character of the disease was worked out by Professor T. J. Burrill, of the University of Illinois, in 1878, and was published to the world in 1880. Dr. Burrill found that the disease is caused by a small germ belonging to the great family of bacteria, which are minute, microscopic plants, the smallest vegetable organism in the world. The pear-blight bacillus is only 1/50,000 of an inch in diameter and about 1/25,000 of an inch in length; under the microscope, when magnified 1,000 diameters, its appearance is that of a hyphen (-).

4. The pear blight germ attacks all species belonging to the pome or apple family, and also in a small way infects plums and the apricot. Among the cultivated fruits, therefore, it attacks the apple, pear, quince, loquat, plum and apricot. The following wild fruits indigenous to the Pacific Coast states are also attacked by it. I shall give the common names and after them the botanical or scientific names, so that students of botany may be able to look them up:

(a) Service berry or June berry (*Amelanchier florida*).

(b) Thorn apple or haw (*Crataegus douglasii*).

(c) Christmas berry or Toyon (*Heteromelés arbutifolia*).

(d) Wild pear or apple (*Malus diversifolia*).

(e) Mountain ash or rowan (*Pyrus sitchensis*).

There are many more species of the above genera to be found in the Eastern and Southern states, but a knowledge of the fact that all pome fruits blight should be sufficient.

5. The damage by blight in the Eastern and Southern states has been such that practically all of the better varieties of pears have gone out and commercial pear growing is an industry of the past.

6. The blight has spread into every known section of the United States, Southern Canada and Northern Mexico; only a very few small districts still remaining free from it.

7. The first appearance of the blight is made evident by the blossoms and young shoots becoming withered and black, finally drying up. Later, branches and limbs, as well as the bodies and root system, become infected. Even the fruit may become infected and wither away.

8. The infections first noted in the spring come from hold-over cases which have resulted from the previous year's infection. These hold-overs may be found in the larger limbs, bodies and roots of the pear, apple, quince, loquat and even wild fruits, though less frequently During the blossoming period these hold-overs ooze and this gummy substance, which is filled with the bacteria, become points for the starting of new infections in the blossoms and twigs.

9. The germs from the hold-overs are carried about by bees and other insects. Biting and sucking insects cause infec-

tions in the young twigs, and even the bodies. Sapsuckers, or woodpeckers may also spread the blight. The use of pruning tools not disinfected also spreads it. The blight may also enter small growth cracks in the twigs, limbs, bodies and roots, and through crown galls.

10. Weather conditions favor the spread of blight, as well as favoring infection. Dry weather tends to prevent not only the spread of infection from tree to tree, but also the spread of the disease in the tree itself. It is as easy to understand this as it is to understand that dry weather prevents growth and germination of seeds and plants.

11. Thunder, lightning and other atmospheric disturbances have no influence whatever on the disease known as pear blight. The precipitation which accompanies them is the only factor besides warmth.

12. The only way to control blight is to remove all cases of hold-over before the blossoming period begins. Hold-overs removed during the blossoming period do not insure that some infection has not taken place from them. To remove hold-overs, or rather to find them, on the rough bodies use a gouge or some other instrument with which to expose the tissues beneath. A water-soaked, reddish condition of the soft bark indicates infection, which should be antiseptically removed.

13. The antiseptic to be used should be bichloride of mercury, or corrosive sublimate. Use no other. This disinfectant should be used at a strength of one to 1,000, or perhaps stronger, but never weaker. The use of the various substitutes is a senseless practice, as there is nothing cheaper or more effective as a disinfectant than bichloride of mercury. It is a deadly poison and must be kept away from children, and the containers should be plainly labeled, so that unsuspecting persons may not be poisoned. Never put in a metallic container; always use glass or wooden vessels.

14. There are no remedies for pear blight, and all so-called patent washes or other "remedies" should be avoided. Anyone who claims to have a cure for pear blight is a "fake," and should be treated accordingly. Those having "remedies" for sale have no standing whatever; if they had they would not oppose every scientific fact known.

15. Summer cutting of blight should always be done, but the work, to be effective, must be done carefully. Always be sure to get below or above the point of infection. If infection is found in fruit spurs or water sprouts never break them off unless you know how far the infection has gone. There is no further danger in the dead spur, but rather in the infection which has advanced beyond it. Breaking off the spur and then applying the disinfectant is not eradicating the blight. Never leave an infection until you know that there is no further danger from it. Remember that there is no such thing as "pretty good work;" the work is either good or bad.

16. In order to render the fighting of pear blight more easy, trees should be pruned in the vase or open-head form. Never grow a tree with a main leader or center. Keep all water-sprouts and fruit spurs off the body and main limbs of the tree. Let no water-sprouts come up from the crown of the tree or the root system. Cut out all crown galls.

17. When blight is prevalent or when seasons conducive to blight occur, extreme caution should be used in the matter of using stable manure, commercial fertilizer or applying too much water. Irrigation practice should be studied carefully, not only in connection with blight control, but with benefits or injuries which may result to the soil.

18. The only way to keep blight under control is to increase the inspection and make it rigid. If a grower is caught experimenting, or not following out the directions for eradicating blight according to the letter of the law, force him by law to do what the inspector has ordered. Besides the regular corps of inspectors there should be volunteer inspectors who will look after their own interests by investigating the condition of neighboring orchards. Their appointment may be

made in the regular way, making them officers of the law having the right to enter upon a neighbor's premises.

Crater Blight

This term is a rather common one among pear growers, but is not applied to any very definite form of disease. It is supposed to signify a dying of certain spots or patches of bark situated on the limbs or trunk. In these patches the bark becomes rough on the outside and dark colored beneath the surface. Some injury of this sort appears to be connected with the disease described above, the bark dying in certain spots rather than in a strip up and down the whole length of the branch or trunk. True pear blight may also cause a similar effect by running in from a small shoot or fruit spur, but many cases of both black leaf and crater blight occur without the presence of the pear-blight organism. Frequently what is called crater blight is really nothing more than the normal roughening of the bark of the pear tree as it grows older. In this tree the bark begins to crack and roughen in patches on the trunk and main limbs, and its normal condition has sometimes the appearance of the outbreak of some disease.

CROWN GALL. See *Apple Diseases*

Curly Bark

This is somewhat similar to the above, the bark cracking in concentric rings in spots upon the surface of the main limbs. It is not of any serious consequence.

R. E. SMITH,
California Experiment Station Bulletin 218.

Frost Belting, or Frost Bands

Pears sometimes present a peculiar russet ring or band caused by low temperature during blossoming time. The trouble is not serious.

Fruit Drop

The young fruit drops from the tree while still very small and immature. Due to imperfect pollination. Ordinarily, results simply in a desirable thinning of the fruit, but sometimes a large part of the crop drops from this cause. May also be produced by frost affecting the fruit soon after setting. Such fruit may remain on the tree and continue to grow for some time after the frost occurs before falling.

HYPCHNOSE. See *Apple Diseases.*

Leaf Blight
Entomosporium maculatum Lev.

Leaf blight of the pear is produced by the leaf-blight fungus, which causes spotting and dying of the leaves, also cracking of fruit. The diseased leaves show a dense, dark-colored coating on the under side. This disease is readily and successfully prevented by the use of Bordeaux mixture as a spray.

Leaf Spot
Septoria piricola Sacc.

Leaf spot of pear is another fungous disease which may flourish despite the use of Bordeaux mixture, as generally applied. This fungus appears not to yield to the standard fungicides. It produces small, circular dead spots in the leaves; the spots in later summer may drop out, leaving holes. It is quite prevalent, but as yet no specific recommendations can be made for it.

A. D. SELBY,
Wooster, Ohio.

Pear Rust
Gymnosporangiose

The rust of the pear is very similar in nature to the rust on the apple. It consists of two stages, a summer stage and a winter stage. The summer stage produces the rust on the leaves of the pear, while the winter stage forms the familiar cedar apple.

The remedy, as in the case of the apple, consists in removing all cedar trees from the neighborhood of the pear orchard, thus eliminating the source of infection. When this is impossible, the pear trees should be sprayed with the Bordeaux mixture immediately after the early rains which cause the gelatinous horns on the cedar apple.

This disease of pears is particularly abundant upon varieties of the Japanese strain.

F. L. STEVENS,
West Raleigh, N. C.

Scab

Venturia pyrina.

The pear scab is undoubtedly the most serious fungous disease of the pear known to occur in Oregon. This disease is abundant throughout the western part of the state, especially in the Willamette and Umpqua valleys and in the coast regions. It does not occur as a serious disease in the Rogue River valley. It is very similar in nature to the scab of the apple, and the general appearance is the same. Fig. 1 shows well the appearance of the disease upon the fruit. Unlike the

Pear Scab.

Fig. 1. Scab on Fruit of Pear. Badly affected fruit may become cracked as shown in left hand specimen.

apple scab, the pear scab causes a disease of the twigs, producing olive-brown cushions of tissue beneath the epidermis, which finally break through, giving a rough appearance to the twigs. Frequently cankers of some size start upon rapidly growing twigs, which not uncommonly may be girdled. There is considerable evidence to show that on the pear the disease may live over the winter on the twigs.

Cause

Pear scab is caused by a fungus which is very similar in morphology and life history to the apple scab, but it is due to a different fungus known technically as *Venturia pyrina.* The summer spore stage of the disease is formed abundantly in the spots on the foliage, fruit and twigs. These are disseminated by the wind and serve to spread the disease. Like the apple scab this fungus produces a sexual spore stage on the dead leaves in the spring.

Treatment

Since the fungus may live over winter on the decaying leaves, it is advisable to plow early in spring, some time before the trees blossom, in order to bury as many leaves as possible. Smith, in California, has studied the disease, and recommends a dormant spray late in the winter, and further advises spraying twice with Bordeaux mixture while the buds are unfolding.

In the Willamette valley pear scab has been successfully controlled by the same methods recommended for apple scab.

Where the disease occurs abundantly on the twigs, as it does particularly in the coast regions, it might be advisable to follow the California method, after previously pruning out as many of the affected twigs as possible. Where orchards have been neglected, and on this account an abundance of twig infection is present, it is probable that several years of careful spraying will be necessary to bring the disease under control. Under such conditions, severe cutting back before spraying, where consistent with good horticultural practice, will aid greatly in subduing the disease.

H. S. Jackson

Sun Scald. See *Apple Diseases.*

Winter Injury to Buds. See *Apple Diseases.*

PEAR PESTS

Aphids. See *Aphids.*

Apple Leaf Hopper. See *Apple Pests.*

Bean Thrips. See *Bean Pests.*

Black Scale. See *Apricot.*

Blight Beetle. See *Cherry Pests.*

Blister Mite

Eriophyes pyri Pgst.

General Appearance

The work of this mite makes its presence easily distinguishable from all others. Pear leaves are so affected as to produce reddish or dark-brown spots which become darker with age and may spread so as to entirely cover and destroy the foliage. On the apple the galls re-

Fig. 1. Pear Leaf Blister Mite Injury on Pear Leaves. (Montana Experiment Station)

main the color of the leaves. The younger shoots suffer most. The mites are very minute and can be seen only with the aid of a microscope. The body is elongated, with roughened surface, transparent and having but two pairs of legs near the head.

Life History

The mites pass the winter on the trees under the bud scales and begin to work upon the leaves as soon as they appear in the spring. The eggs are deposited in holes bored into the underside of the leaves. The work of the young after hatching causes the galls or swellings. The destructiveness continues throughout the summer and until the leaves begin to fall in winter. There are several generations each year.

Food Plants

The pear and apple are seriously affected, the mites attacking the foliage as well as the stems of the leaves and fruit. On the foliage of the pear the galls are made along the sides of the midribs of the leaves; on the apple at the base and along the margins of the leaves. Other plants found as hosts are white beam tree, European mountain ash, wild service berry, common cotoneaster.

Control

Same as for the common red or six-spotted spider or mite. (*Tetranychus bimaculatus* Harv.)

E. O. Essig

Borers, various species. See *Apple Pests.*

Bud Worm

Bud worms may be controlled by spraying with either Paris green, arsenate of lead or Bordeaux arsenical when leaf buds open. Repeat in six days if necessary.

California Tussock Moth. See *Apple Pests.*

Cherry Scale. See *Cherry.*

Cigar Case Bearer. See *Apple Pests.*

Citrus Thrips. See *Orange Pests.*

Citrus White Fly. See *Orange Pests.*

Climbing Cutworms, various species. See *Apple Pests.*

Codling Moth. See *Apple Pests.*

Cotton Maple Scale. See *Apple Pests.*

Eye-spotted Bud Moth. See *Apple Pests.*

Fall Canker Worm. See *Apple Pests.*

Fall Web Worm. See *Apple Pests.*

Flat-headed Apple Borer. See *Apple Pests.*

Florida Wax Scale. See *Orange Pests.*

Frosted Scale. See *Prune Pests.*

Fruit Bark Beetle. See *Shot Hole Borer,* under *Cherry Pests.*

Greedy Scale. See *Apple Pests.*

Green Apple Aphis. See *Aphids.*

Green Apple Worm. See *Apple Pests.*

Horn Tail. See *Raspberry Pests.*

Leaf Crumpler. See *Apple Pests.*

Leaf-Eating Caterpillars

There are a number of species of leaf-eating caterpillars. In all cases of attack no damage will occur if arsenical poison sprays are employed. Arsenate of lead at a strength of three pounds in fifty gallons of water or Bordeaux mixture is a safe treatment. Paris green, at the rate of one ounce to ten gallons of spray mixture, is also effective, but is washed off the foliage by rains more quickly than the arsenate of lead. The sprayings with Bordeaux mixture necessary to prevent leaf diseases will also control practically all caterpillars, if arsenical poisons are added.

Lesser Leaf Folder. See *Apple Pests.*

Mite

Phyllocoptes schlechtendali nalepa

The introduction of this mite into the pear and apple orchards of Southern Oregon (Rogue River valley) has been comparatively recent. The writer found it for the first time in the summer of 1910, but it was thought to be of slight importance at that time and little attention was given it. Since that time, however, it has been very conspicuous in many pear orchards throughout the valley, and its effect upon the trees was so noticeable this season as to attract general attention.

It is interesting to note that Parrott* makes mention of it as very common on apple foliage in the United States, but does not seem to consider it a serious pest. However, the writer has noted that apple foliage is not seriously attacked, while the foliage, terminals of twigs, and frequently the fruits of the pear are most subject to injury. In fact, the presence of the mite on apple foliage seems to be of little importance, as no serious injury because of its presence has ever been observed.

* Bulletin No. 283, New York Agricultural Station, 1906.

Fig. 2. Pear Leaf Blister Mite Injury on Leaves. (Montana Experiment Station)

In this district this mite seems to be of economic importance to the pear growers. The injury resulting from its presence in the pear orchards is generally apparent during the latter part of June or early July. The foliage has a peculiar rust or russet appearance on the under side and is also somewhat curled, as though by drought. There may be some slight russeting on the upper side, but this is rather uncommon. The terminals of shoots are also attacked and have the same brownish appearance of the under surface of the foliage. Where the attack is serious, the whole tree has a brownish appearance and the trouble has been given the local name "rusty leaf" by the fruit growers. During the latter part of July and through the month of August, badly injured trees shed the foliage from their terminals. The terminals have a somewhat shriveled appearance, the epidermis being brownish-black or black. Very often the injured epidermis is cracked or broken, due to the expansion of the growing tissue beneath. The fruit is also attacked and is russeted and cracked in the same manner as the terminals.

The injury to young pear trees is usually greater than to older bearing ones. Sometimes almost complete defoliation of the young tree results before it has had its season's growth, and besides the epidermis of the growing shoots has been injured. Fortunately, this mite is very easy to control. As in the case of all of our economic species attacking plants, the use of lime-sulphur, dry sulphur, oil emulsions, etc., will completely control it. Since it is a surface-feeding mite, producing no galls, it would seem that there should be no trouble in eradicating it.

P. J. O'Gara,
Pathologist, Medford, Ore.

Notch Wing

Ennomos magnarius Guen.

This caterpillar appears occasionally upon pear and apple as well as a large number of other plants. Its distribution is quite general, but it does not seem to be important economically. Wherever spraying is done for codling moth, this species is not likely to become abundant.

Oblique Banded Leaf Roller. See *Apple Pests.*

Oyster Shell Scale. See *Apple Pests.*

Pear Blight Beetle. See *Shot Hole Borer*, under *Cherry Pests.*

Pear Leaf Blister Mite. See *Blister Mite*, this section.

Pear Leaf Miner

Ornix geminatella

The pear leaf miner is a very small, dark, steel-gray moth, expanding about one-third of an inch. The larva mines in the leaf tissues of both apple and pear. It sometimes draws two leaves together, tying them with silken fibers; again, it may fold up in a single leaf. Since it passes the winter inside the fallen leaves, as a larva, or as a pupa, its numbers can be thinned, if it should become numerous, by collecting and burning the leaves soon after they drop in autumn.

H. A. Gossard,
Wooster, Ohio.

Pear Psylla

Psylla pyricola Foerst.

General Appearance

Adults are small, orange yollow, jumping insects, not unlike miniature cicadas. More common than the adults are the nymphs, which are queer looking creatures with wide flat bodies and large heads. The general color is orange with dark striped thorax and blackish-brown abdomen. In the mature winged form the abdomen is greenish.

Life History

The insects appear with the first healthy growing shoots, which they attack vigorously. They increase rapidly and often do great damage. All stages are to be found throughout the summer months.

Food Plant

The pear.

Control

Same as for plant lice (*Aphididae*), consisting of soap and emulsion sprays.

Natural Enemies

The two-spotted ladybird beetle (*Adalia bipunctata* Linn.) and the green lacewing (*Chrysopa californica* Coq.) feed

upon the eggs and larvae of the pear psylla.

E. O. Essig

Pear Slug. See *Cherry Pests*.
Periodical Cicada. See *Apple Pests*.
Pistol Case Bearer. See *Apple Pests*.
Plum Curculio. See *Plum Pests*.
Red Scale. See *Grape Pests*.
San Jose Scale. See *Apple Pests*.
Scurfy Scale. See *Apple Pests*.

Sesian

Sesia pyri

Throughout all of the autumn months a borer may be found working in the bark of pear and sometimes in that of apple trees. Its presence is indicated by castings, resembling fine sawdust, thrown out upon the bark of the tree. The larva is whitish to pink and does most of its feeding under and in the bark, injuring the sapwood but little. The adult is a clear-winged moth, having a wing expanse of about three-fourths of an inch and a pair of yellow bars crossing the abdomen transversely; a fan-shaped tuft of hairs at the end of the abdomen is of the same color. It appears in summer and deposits the eggs for the worms which appear in early fall. It is known as the apple or pear sesian. The most satisfactory method of destroying the worms is to dig them out and kill them. Whitewashing or painting properly the trunks of the trees in early summer is probably of some value in discouraging egg-laying.

H. A. Gossard,
Wooster, Ohio.

Shot-Hole Borer. See *Cherry Pests*.
Spring Canker Worm. See *Apple Pests*.
Tarnished Plant Bug. See *Strawberry Pests*.
Tent Caterpillar. See *Apple Pests*.

Pear Thrips

Physothrips (Euthrips) pyri Daniel

S. W. Foster

Distribution

The pear thrips is at the present time very destructive in the San Francisco bay region and the larger part of the lower Sacramento valley of California. More recently it has been found in destructive numbers throughout New York state and Northwestern Pennsylvania.

Economic Importance

It is at the present time the most important insect pest with which the growers of deciduous fruits in the sections mentioned have to contend. On account of the minute size of the insect, the rapidity of its spread over large areas, and the suddenness of attack in great numbers—completely blasting in a few days all prospects for a crop—the control of this pest is a matter of considerable difficulty. As the insect is each year extending its range of food plants, its capabilities for dissemination are correspondingly increased. There is no reason to believe that the insect will disappear, it should be regarded as a permanent and serious pest. Conservative estimates place the damage caused by the pear thrips in California during the years from 1904 to 1912 at least $6,000,000. It is safe to say that the thrips in the absence of treatment would cause an average yearly loss to the state of over $1,000,000.

Character of Injury

Injury to the various fruit trees by this species is caused by the feeding of the adults on the developing buds and yearly blossoms; by the deposition of eggs into the fruit stems, leaf stems and newly formed fruit, and by the feeding of the larvae in the blossoms and on the young fruits and foliage. On pears the greater injury is produced by the adults, which often prevent the trees from blooming, while on prunes and cherries the larvae frequently prevent a crop of fruit from setting after the trees have come into full bloom. Also, the deposition of eggs into the fruit stems of prunes and cherries so weakens the stems that much of the young fruit falls. By rasping the tender surfaces in the developing fruit buds and the young fruits with their hardened mouthparts, the thrips rupture the skin, causing an exudation of sap which is often followed by more or less fermentation, especially before blooming. The feeding by larvae

on prunes after blooming causes the well-known thrips "scab," while most of the scarred and misshapen pears are caused by the work of the adults.

Life History

Adults

The adults or winged form of the thrips first appear on the trees about the middle of February, appearing in greatest numbers in late February and early March.

By the time the fruit buds have swollen sufficiently to separate the bud scales slightly at the tip the adults force their way within, feeding upon the tenderest portions inside the buds.

Eggs

As soon as the first leaf surfaces or fruit stems are exposed egg-laying usually begins, depending somewhat on the variety of fruit attacked. Egg-laying begins the first days of March and continues till near the middle of April. Most of the eggs are deposited just under the epidermis in the fruit stems, young fruit and leaf stems. The eggs require about eight days to hatch.

Larvae

By the time the trees are breaking into full bloom the adults have done most of the damage caused by their feeding, and oviposition is at its height. Many of the earlier appearing adults are dying off and larvae are beginning to appear in numbers. The very first larvae can usually be found about March 20, and are in maximum numbers on the trees, feeding on the small fruit and young foliage, from the first to middle of April. Reaching their full development, the larvae drop from the trees of their own accord or with falling calyces, or are blown by wind or knocked off by rain. After the middle of April the number on the trees diminishes rapidly and by the last of April all the larvae are off the trees and in the ground. Here they work down into the first three or four inches of hard soil below the loose surface mulch and construct a tiny cell, where they remain until the following spring.

Pupae

The larvae mostly remain as such in these cells till September, when pupation begins, pupae being most abundant during October and November. Many adults can be found in the ground in December, and by the first of January practically all the thrips are in the adult stage and apparently ready to emerge and go into the trees whenever conditions are right. Broadly speaking, the thrips spend two months of the year in the adult, egg and larval condition on the trees and the other ten months of the year as larvae, pupae and adults in the ground.

Control Measures

The pear thrips is in some respects an unusual insect in that it remains in a dormant or semi-dormant condition for about ten months of the year. Although on the trees for only two months out of the twelve, it is able in this short time, in the absence of treatment, to completely destroy all prospects of a crop of fruit, in many cases within a very few days. The trees are attacked at the period of bud swelling and blossoming, when they are most susceptible to injury. These minute insects come literally in swarms, and may, if left alone, completely destroy all of the fruit buds of an orchard in four or five days. Many cases have been known where a delay of four or five days in spraying resulted in loss of the entire crop of fruit, and in some cases half of all the buds were killed in three days after the thrips appeared on the trees in great numbers. In view of this condition it is very evident that any means of control must be very thorough and done in the most exacting manner at the proper time.

Cultivation

On gravelly and sandy soils plowing to a depth of from seven to nine inches results in killing from 60 to 80 per cent of the thrips present in the soil, but is not a sufficient control, as enough thrips escape to cause great injury to the buds the following spring.

Spraying

A tobacco extract containing 2¾ per cent nicotine, diluted at the rate of 1 to 60 in a 6 per cent distillate-oil emulsion, kills all the thrips touched and penetrates well into the pear cluster buds. The pubescent covering of the individual buds in the cluster, being resistant to water, seems to act on the dilution in distillate-oil emulsion in much the same manner as the wick upon oil in a lamp.

Distillate-Oil Emulsion Home-Made Preparation

To make soap use this formula or some multiple of same:

Water, gallons	6
Lye (98 per cent), pounds	2
Fish oil, gallons	1½

Put the water in a caldron or boiler and add the lye. When the lye is thoroughly dissolved and the water boiling, pour in the fish oil, stirring in the meantime, and boil slowly for two hours. When the soap has boiled sufficiently it should give a ropy effect when stirred and brought up upon the ladle. This formula gives about 40 pounds of moderately firm soap.

Growers are cautioned to buy only genuine fish oil and not a fish-oil compound or a mixture of fish oils and vegetable oils. Herein lies part of the secret of the penetrating efficiency of the distillate emulsions made by using animal-oil soap as the emulsifier. The cost of the soap is $0.0165 per pound made from fish oil at 35 cents a gallon.

The distillate-oil stock emulsion should be made as follows:

FORMULA*

Hot water (boiling), gallons	12
Fish-oil or whale-oil soap, pounds	30
Distillate oil (raw) 30° to 34° Baume, gallons	20

Have the water boiling hot when put into the spray tank and add the soap immediately while the agitator is running at a good speed. When the soap is all thoroughly dissolved, pour in the oil slowly, keeping the mixture well agitated while the oil is going into the tank.

* For a spray tank of 200 gallons capacity, five times this formula can be made at one time.

When all the oil is in and well mixed, pump out through the nozzles at good pressure (not less than 175 pounds) into storage tanks.

No one should attempt to make this stock emulsion without a power spraying machine, as thorough agitation and high pressure are important requisites. Also, care should be used in having measurements reasonably exact, the water boiling hot and soap thoroughly dissolved before any oil is put in. This stock emulsion contains approximately 55 per cent oil, and to make a 3 per cent emulsion use 5½ gallons of this stock in each 100-gallon tank. To dilute, first put the stock emulsion in spray tank (have the agitator going), and then add the water, keeping the agitator running all the time. This is important with the commercial preparations as well as with the home-made emulsions. For the combination sprays of oil emulsions and nicotine solutions, the nicotine should be added last, that is, after the oil emulsion has been diluted to the desired strength. These solutions should not be mixed together without first diluting one of them.

This concentrated emulsion will cost the grower about 5 cents per gallon, as most of the various distillates used for spraying cost from 5 to 10 cents a gallon in drum lots and home-made soap costs about 2 cents per pound.

Experiments conducted thus far indicate that success is more uniformly obtained by using an untreated raw distillate 32 to 34 degrees Beaume with comparatively high flashing point.

It was found that fruit from sprayed trees was nearly free from scab, was larger, and on account of yield and quality showed a net profit of $127.44 per acre over the non-sprayed. Similar results followed the use of spray in pear and cherry orchards.

Recommendations

Spraying is by far the most satisfactory means for controlling the pear thrips on all classes of deciduous fruit trees. However, to spray successfully

involves an entirely different conception of the operation than as ordinarily practiced against other orchard insects. Only the most efficient spray materials should be used, namely, the combination of distillate-oil emulsion and tobacco extract or distillate-oil emulsion and nicotine solutions. The spraying must be thoroughly done and put on the trees when the thrips appear in numbers, not waiting till many buds have been destroyed. It is strongly advised to use power machines, and growers are urged to use them for all the spraying, and to have a tower platform elevated over the tank so that one man can thoroughly drench the tops of the trees. It is absolutely necessary to use high pressure—from 150 to 200 pounds—and only angle nozzles should be employed, and these must be held close to the bud clusters to force the spray directly into the ends of the buds. This is absolutely necessary to secure good penetration and get satisfactory results. Plenty of material—three to five gallons per tree for pears, depending on the size of the tree—should be used; more liquid is required for large prune trees; large cherry trees may require seven to eight gallons per tree for satisfactory results. Only two rows should be sprayed at a time, using three men, one on the tower to spray the tops of the trees, thus reaching all buds pointing upward, and two men on the ground (one to each row) to spray the lower buds and those pointing downward or laterally.

Timing the Applications

Method

The spraying must be done on time and for the best results all the trees should be treated within a few days. During the season of 1910 more of the failure to get satisfactory results was due to lateness of application than to any other one cause. Thrips were in the trees and in great numbers before many of the growers purchased their spraying supplies, and in many cases half the buds were entirely destroyed and the others badly injured before the trees had been given even the first application. The grower should have everything in readiness, all materials on hand, concentrated emulsion made up and spray machinery in perfect working order by the first of March and have all other orchard work in such shape that when the thrips appear in numbers the spraying may be done at once and before the buds have been seriously injured by the feeding of the adults. The grower should have enough spray machines to cover the orchard quickly. At least one good power outfit is necessary for every 30 acres of orchard.

Schedule of Applications

In badly infested orchards three applications are necessary. Two of these sprayings should be directed against the adults and one against the larvae, and to obtain satisfactory results must be timed properly.

First Application

The first spraying should come as soon as the thrips can be found on the trees in numbers, about March 1st.

Second Application

The second spraying, which is also for adults, should come from four to ten days after the first, depending somewhat on variety of fruit, stage of bud development and rapidity of emergence of thrips from the ground. On pears this will usually be just as the earliest cluster buds are spreading, and on prunes and cherries when the tips of the petals first begin to show.

Both of these applications are important and necessary to insure the production of a good crop of uninjured blossoms. The nozzles should be held close to the bud clusters and the spray directed into the ends of the buds. This makes it necessary that the spraying be done mostly from above.

Third Application

The third spraying is for larvae and properly comes just as most of the petals are falling from the trees, depending somewhat upon the variety of fruit. In any case the small, white, active larvae

can be easily seen, and when they first become abundant spraying should be done. Spray the under side of the leaves where the larvae are at work.

Summary

The pear thrips can be controlled by thorough spraying on any variety of the deciduous fruits grown in the infested areas.

The sprayings necessary to control the thrips are expensive, but the outlay of money and labor gives large returns. Many experiments in spraying have given net returns of from $100 to $600 per acre more than was secured from adjoining untreated areas.

The thrips work rapidly and may destroy all prospects of a crop in less than a week's time. Spraying, to be successful, must be done thoroughly and at the time to kill the thrips before the fruit buds have been destroyed.

Those who can do so successfully are advised to irrigate and plow in the fall. This is to be followed by thorough spraying the following spring.

When the thrips begin to appear on the trees in numbers, spraying should be done thoroughly, using high pressure, holding nozzles close to buds and directing the spray directly into the ends of the buds and not against the sides.

Growers should not attempt to spray too many trees with one machine. More profitable returns will be gained by spraying half of the orchard thoroughly and at the proper times than by spraying all the orchard poorly one time. Results of the work in 1909 to 1912 show conclusively that one application is not sufficient when the thrips are abundant.

Tussock Moth. See *Apple Pests*.

Walnut Mealy Bug. See *Walnut Pests*.

Walnut Scale. See *Walnut Pests*.

White Lined Sphinx. See *Cantaloup Pests*.

White Peach Scale. See *Peach Pests*, under *West India Peach Scale*.

Woolly Apple Aphis. See *Aphids*.

Pearmain, Blue, Apple for Massachusetts. See *Massachusetts*.

Pecan

The pecan, *Hicoria pecan*, is a species of hickory, indigenous to North America, especially the United States. It belongs to the walnut family and is one of the most profitable commercially of any one of that species. It grows to a height of 100 feet, and under favorable conditions of deep alluvial soil and plenty of moisture will live to a great age and bear nuts of great commercial value. Trees are now living and bearing in Texas and other Southern states that are said to be 300 years old. Since the pecan has come to be regarded as commercially important and profitable there has been much discussion as to what sections of the country are best adapted to its production. This question is hard to settle. It grows as far north as Central New York and as far south as the Gulf of Mexico. It seems not to produce profitably for commercial purposes in the latitude of New York, but is profitable in all the Southern states. Louisiana, Texas, Georgia, Alabama, North Carolina, Virginia and Mississippi all lay claims to special adaptation to its production. It is also well adapted to the sections drained by the Mississippi river as far north as Central Illinois, Central Indiana and other sections in the same latitude. Just now there is a great awakening of interest upon the subject, and many orchards are being planted to improved varieties.

Granville Lowther

PROPAGATION

Pollination

Since two kinds of flowers are produced on the pecan, one bearing the pistils, the other stamens, the pollen must be transferred from the latter to the former in order that pollination may take place. In many plants the pollen is transferred from one plant to another by means of insects, but in the pecan there are no bright colors, no nectar, no scent to attract insects to carry pollen, but, instead, the wind is the carrying agent and it needs no attractions. Pollen

is produced in large quantities, necessarily so, since much of it is wasted.

BUDDING THE PECAN

Difficulties Encountered in Pecan Budding

*The propagation of the pecan has hitherto been one of the principal drawbacks to the successful cultivation of this nut tree. In budding and grafting the percentage of successful unions in the total number of plants worked has been small. Much of the work of pecan propagation has been along similar lines to those favorable to the propagation of well-understood subjects, such as the apple, peach and other fruit trees. Consequently the pecan has earned the reputation of being difficult to work on stocks of the same or allied species. This is not to be wondered at, as mistakes are very easily made in the selection of working material, time of operating, etc.

The principal trouble encountered in pecan budding is due to the selection of wrong material from the tree to be propagated. By the use of a method which has been devised for budding the pecan and the selection of one-year-old buds the outlook is good for very successful propagation. It will be seen where some of the trouble lies if the budding of the peach is compared with that of the pecan. In the case of the former a shoot of the current year's growth will by the latter part of August give a very large number of buds which can be worked successfully. This is not the case with the pecan.

Why the Pecan Should Be Budded

It has been ascertained that seedlings from nuts of the choice varieties do not come true, resembling in this particular many of our popular fruit trees. Many of these seedling pecans bear nuts not much superior to the common wild forms. After waiting several years for the seedling trees to bear, this naturally causes the grower a good deal of disappointment. So, necessarily, as with apples, peaches and other fruits, the only way in which the choice varieties of the pecan can with certainty be perpetuated in a manner to permit of being handled by dealers, is by budding or grafting on seedling stocks.

Raising Seedling Stocks

Up to the present time it has not been demonstrated that there is a better stock for the reception of buds or grafts of the pecan than seedling stocks of the same species. In raising pecan seedlings for stocks it is advisable to select seeds from trees at the northern limit of the pecan belt.

The seed nuts should be secured as early as possible after they are ripe, and, late in the fall, stratified. For this purpose it is most convenient to use boxes, say three feet long, one foot wide and three inches deep. A mixture of sand and ashes in about equal proportions is a good medium in which to imbed the nuts. A layer of this material one inch thick should be placed in the bottom of a box, then a layer of pecans as close together as possible. It is not advisable to put more than a single layer in a box, because of the brittle nature of the root, the nuts being somewhat irregular in sprouting. Each box is then filled with the sand and ashes, and all the boxes used should be piled together to a convenient height. They should occupy a sheltered position out of doors and be covered with a considerable thickness of straw, mats or old sacking until the nuts show signs of germinating, which will usually occur toward the end of April. To give facilities for inserting the buds on the north side of the seedling stocks, the nuts are then planted in rows running east and west. The rows should be three feet apart and the nuts placed five inches apart in the row. It is not possible the first season to raise seedlings which are large enough to be used as stocks, but in order to secure a good, stout growth, so as to have them large enough for working the second season, the soil should be deeply worked with a plow, rolled, and when necessary harrowed several times until it is well pul-

* Condensed from Bureau Plant Industry Bulletin 38.

Plate I, No. 1—Branch of pecan, showing growth of two seasons, with old and new buds; (a) one-year-old dormant bud; (b) current season's buds; (c) small plump buds at base of growth, from which the leaves fall early. No. 2—Twig of pecan: top part of season's growth, showing buds during winter; (a) flower bud; (b) terminal bud. No. 3—Fruiting branch of pecan, developed from bud shown in No. 2, a; (a) buds from which the growth of the following season is developed, the buds (b) remaining dormant. No. 4—Seven-year-old branch of *Hicoria laciniosa*: (a) growth made from buds which stayed dormant during seven years; (b) dormant bud in good condition. No. 5—Patch budding: two-year-old seedling pecan with piece of bark removed; (a) bud with section of bark attached, ready to be fitted on stock. No. 6—Seedling pecan stock, showing incisions made in the bark with a knife previous to lifting the bark; (a) bud with section of bark which has the sides shaved down, ready to be inserted under the bark of the stock. No. 7—Seedling pecan stock, with bark raised and ready for bud to be inserted.

verized. The remaining part of the work must be done by hand.

Selection of Dormant Buds

After a series of trials with buds of the current season's growth and those of the preceding season, none but those which were formed during the season preceding the operation of budding are recommended for use. The dormant buds (Plate I, No. 1, A) during the month of June are ready to burst into active growth when given the slightest encouragement. Moreover, they can be very easily removed from the bud stick, together with a section of thick, solid bark. The bark on the old wood can be handled without being injured in any way, and it is in every particular splendidly adapted for successful work. After the union has taken place and the stocks are cut back, the bud will give a stronger growth and attain a greater length than growths from the current season's buds. In using buds from the current season's wood (Plate I, No 1, B) many difficulties will be encountered, and the results will be found disappointing. Until the season is pretty well advanced the current year's bark is very thin and more or less succulent, and it can not be removed from the wood without being bruised. Sometimes, even when the greatest care is exercised by the operator, it will split lengthwise and be rendered useless. Again, especially up to the latter part of July, the cuticle is very apt to peel, and where it does stay on it is almost certain to be bruised in the operation of tying. Another serious objection is the presence of the leaf stalk. This, shortly after the bud is inserted, will shrivel up and fall, or it can easily be detached; but the scar left, which in most cases is a large one, is, it is thought, the channel through which a large part of the sap of the bark is lost before it has had an opportunity to unite with the cambium of the stock.

Location of the Buds

It is important that the position which the dormant buds occupy on the branches be accurately understood, so that the proper ones may be selected for the work of budding. They are to be found on the branches made the year preceding that in which it is desired to insert the buds. The pecan trees which have been examined in the vicinity of Washington show exceedingly few growths from terminal buds. The growth of a season starts from one of the large axillary buds near the apex of the preceding year's growth (Plate I, No. 2, A). Two or more of these buds may produce growths, but commonly only one. In fruiting branches the nut cluster takes the place of the terminal bud on the young wood, as seen in Plate I, No. 3. The strong shoots from these axillary buds when one year old are the ones which give good material for budding. Each bud will be found immediately above a leaf scar of the preceding season (Plate I, No. 1, A). Those buds which are nearest the base of the shoot are the smallest and firmest; consequently they are the best fitted for the work. Regarding the period during which buds retain their power of bursting into active growth, Plate I, No. 4 shows a seven-year-old branch of an allied species of hickory *(Hicoria laciniosa)* with three small growths from dormant buds made during the present season, together with a bud quite dormant and evidently able to persist for some time. In the selection of bud wood it is preferable to cut the branches from the tree to be propagated in the early part of the day, choosing shoots as large in diameter as possible and those which show the greatest number of short, plump buds. Immediately on severing the branches from the tree the growth of the current season is severed and discarded and the one-year-old bud sticks are wrapped in dampened newspapers. If necessary, they can in this manner be kept for several days without danger of drying out.

An Improved Method of Budding

A method which has been demonstrated to be a perfect way in which to bud the pecan, and one by the use of which there are very few failures, is as

No. 8

No. 9

No. 10

No. 11

No. 12

No. 13

Plate II, No. 8—Seedling pecan stock, showing bud in position ready to be tied. No. 9—Budded seedling pecan, the wings of bark on the stock almost covering the bud section; both are securely held in position while the union is being accomplished. No. 10 -Budded seedling pecan, showing the method by which the narrow strip of waxed cloth should be applied. No. 11—Budded seedling pecan, covered with paper. No. 12 -Triangular budding; bud ready for insertion. No. 13—Branch of pecan, showing shoots from buds near nut cluster of previous season.

follows: For the reception of the bud make two transverse cuts in the bark of the seedling stock (Plate I, No. 5) a few inches above the ground line, these two cuts, about one inch apart, to be connected by a longitudinal incision. The bark at each side of the longitudinal cut is then raised far enough (Plate I, No. 6) to admit of the insertion of the section of bark on which the bud is situated (Plate I, No. 5, A). The rectangular section of bark when prepared for insertion must be of exactly the same length as the cut in the stock. It is taken from the stick of buds by making two transverse cuts through the bark at equal distances from the bud. (For this purpose a special double-bladed budding knife is used. These blades are placed on a handle parallel to each other about three-quarters to an inch apart.) Two longitudinal cuts are then made through the bark, leaving the bud in the center of the patch, which should be a little over one inch long and five-eighths of an inch wide. The patch must be raised carefully from the bud stick to guard against breaking and with as little bending during the operation as possible. When the operator finds that he does not succeed at the first trial, it will be advisable to practice for a time on wood which is of no value. The stick of buds should be grasped firmly in the left hand, with the knife held by the fingers of the right, the thumb resting on the bud stick. Insert the point of the knife at one end of one of the longitudinal cuts, pressing the blade toward the thumb; this pressure will start the bark. Next insert the end of the handle of the knife, gradually removing the section. The patch is prepared for insertion by first cutting the two ends as straight as possible, using a very sharp knife. The outer bark at the sides (Plate I, No. 6, A) is then shaved off, so that the edges will make a perfect fit when under the bark of the stock (Plate II, No. 8). When the bud is securely in place, the two wings of bark on the stock are bound firmly over the bud section with raffia (Plate II, No. 9), and, as a preventive against the admission of water during the process of uniting, a little soft grafting wax may be smeared across the upper transverse cut and the whole wrapped with a narrow strip of waxed cloth (Plate II, No. 10). The wrapping should be started at the bottom, each wrap being half covered by the succeeding one; this will effectually keep out moisture during wet weather. As a protection against the heat of the sun, strips of paper eight inches long by six inches wide should be tied around the stem of the stock an inch or two above the bud, but covering it (Plate II, No. 11), allowing the bottom part to remain open. After the sixth day the paper covering should be removed, and after the tenth day the waxed cloth may be taken off. By the fifteenth day the buds will have united sufficiently to allow of the removal of the raffia. This method of budding will be found to give an exceedingly satisfactory union. Experience has shown that with carefully selected buds from one-year-old wood and healthy, vigorous growing seedling stocks, every section of bark will unite.

Other Methods of Budding

Sometimes, when the seedling stocks are small and the size of the section of bark necessary for the union will more than cover half of the circumference of the stem of the stock, a quick growth on the part of the stock will produce a swelling immediately above the upper transverse cut in the bark. This can be averted by the use of a triangular patch bud (Plate II, No. 12), with one of the angles pointing upward. In using this method care must be taken that the three sides of the bud section should exactly fit the sides of the space prepared for them. It will be found advisable to smear a small quantity of soft grafting wax over the cut parts after the bud is in position and before tying with raffia. This makes an exceedingly neat union and is best used with small buds. Large ones need a larger section of bark attached.

In patch budding (Plate I, No. 5) a rectangular piece of bark, similar in size

to that given in Plate I, No. 6, is taken from the bud stick. A corresponding piece is removed from the stock and the section from the bud stick carefully fitted in its place. It is then tied with a strand of dampened raffia, but this is used only to keep the bud firmly in place; the top and bottom of the section are left uncovered, because there is a danger of the raffia injuring the cut ends, which are held tightly in place by narrow strips of waxed cloth covering all but the bud. A wrapping of paper is then given, as already described. The principal objection to this method of budding is that the sides of the bark are apt to rise somewhat during the growth of the stock. This, while in no way injuring or retarding the growth of the bud, does not have a very neat appearance for some time after the union is effected and may have a tendency to weaken the point of union, besides giving opportunities for harboring noxious insects.

Starting Buds Into Growth

It is desirable that the buds be started into growth as soon as possible after it has been ascertained that the union has taken place. Buds which are united to stocks having a large section of bark attached are liable to have more or less of the bark decay during the winter months. This occurs principally with young buds, especially when they are worked on one-year-old wood. This would seem to be common to all the species of the hickory family, but where one-year-old buds are used the danger is lessened considerably. However, in the latter case they lose their vigor in proportion to the time they remain on the stock without being encouraged to break.

In order to force the bud into growth it is necessary that the top of the seedling stock be removed, leaving only one or two healthy leaves at the base of the present season's growth. In a few days the buds in the axils of these leaves will push out, and they should be removed as soon as they can be handled, and on down the stem the small dormant buds formed in the axils of the leaves of the preceding season will burst into active growth and must be rubbed off at once.

The practice of tying the growth of the scion to the top of the stock is a good one; it not only saves the soft growth from being whipped about by the wind, but it also secures a close, upright growth. At the beginning of the second season all of that part of the stock which is above the union should be carefully removed, not with a pair of pruning shears, but with a sharp knife, so as to leave a cleanly cut surface, with the bark uninjured. The cut surface should be covered with melted grafting wax to prevent decay.

Transplanting Budded Trees

The pecan is usually regarded as a difficult subject to deal with in transplanting. A large percentage of the trees die back after being placed in their permanent positions from nursery rows. However, if certain precautions be observed it will be found that there is no ground for the supposed difficulty, as the pecan will withstand the ordeal of transplanting in a young state quite as well as any other forest tree. In transplanting the pecan its requirements must be carefully considered. In a young state it is a very deep-rooting subject, and any attempt to change its nature by coaxing the roots to grow near the surface of the soil will end disastrously.

To insure the growth of the trees after transplanting it is very necessary to avoid excessive trimming of the branches and roots. There must be at least one healthy undisturbed shoot of the previous season left on the plant untouched, because the large, plump axillary buds near the tip of the shoot will come into leaf with greater certainty and more quickly than will older buds on cut-back growths. Especially is this the case after the tree has undergone removal, involving the tremendous disturbance of the root system, which almost completely robs the plant for the time being of its water supply. Seedlings in nursery rows with undisturbed roots, when trimmed down to the small lateral buds on

one or two-year-old wood, will start as readily, if not as strongly, as the buds near the end of the most recent growth. It must be remembered that the terminal buds of the pecan very seldom grow. They sometimes do so in seedling, but very seldom after a certain age. This is shown in Plate I, No. 3, and Plate II, No. 13, which represent the growths made during three seasons. In Plate I, No. 2, the large, plump bud near the terminal contains the flowering branch. The branch shown in Plate I, No. 3, is developed from this bud. Plate II, No. 13, shows a still further development. The small, dead stump between the two living shoots represents the position occupied by the nuts the preceding year, while the two shoots are from two of the large buds near the nut. (Plate I, No. 3.)

In transplanting young trees, especially those which are to a certain extent weakened by the operation of budding, it is impossible to save all of the lateral roots during the operation of digging from the seed rows. It is, however, very desirable that as few as possible be sacrificed. Very careful lifting will pay for the extra labor. In seedling trees the taproot is usually severed much too near the collar and at too early a stage. It must be allowed to grow the first and second seasons if the seedlings are to be budded, because when removed at the end of the first season or the beginning of the second the weak growth will render it impossible to perform any budding operations during that year. Therefore, it is not till the third year that the taproot can be interfered with, but it is well not to risk touching it until the growth of that season is completed, for the reason that although the shoot made from the inserted bud makes considerable growth the same season it is put on, it will make very large growth the season following. The budded seedlings will then bear removal. They may have a small part of the taproot removed and be either planted permanently or in nursery rows. The budded seedlings of the present day, if the variety be a good one, are retailed at about $2.50 apiece. When the tree brings that amount—and the supply is understood to be far short of the demand—it should be furnished with good roots. If it is worth that sum to the purchaser, it is certainly entitled to a little further expenditure of time and care in the preparation of suitable conditions under which to grow. The retention of roots at least 2½ feet below the surface of the soil is desirable. If the ground in which the young trees are to be placed is not composed of good soil to that depth, it should be supplied. A good start the first year after planting means everything to the future tree; a bad start will, in the majority of cases, mean a sickly tree for a long time and an unprofitable investment in the end. With the roots deep in good, light, loamy soil the tree is to a certain extent independent of moisture from the surface. When growth begins in earnest, the roots will grow in the direction of the food supply. The severance of a large portion of the taproot saves a good deal of labor in digging and planting, but it means a complete defeat of nature's method in supplying the wants of the tree. Anyone who tries the two methods and compares the results will be convinced in one season in favor of large roots.

As a further precaution the roots should be plunged in liquid mud the moment they are free from the soil and never be exposed for a minute longer than is necessary, as they too aften are, to the drying influence of the air. After taking from the mud the roots should be wrapped in damp sacking, moss or any other material which will hold moisture and kept in this condition until they are about to be planted. They should then be again plunged in liquid mud and while this is hanging to the roots they should be planted. When the soil has been well firmed about the roots of the tree and the hole is about two-thirds filled with soil, the remaining space should be filled with water. When this has disappeared, fill in the rest of the soil. A mulch of short grass, stable litter or half-decayed leaves left on during

the summer will supply favorable conditions. If these little details are faithfully attended to there is little danger that unsuccessful results will follow. A little extra expense is involved at first, but careless handling will be far more costly in the end.

G. W. Oliver

Top-Working

It is often advantageous to top-work trees in order to take advantage of time by utilizing stocks which have become well established, and to secure better varieties or disease-free trees. It is sometimes advantageous to top-work native trees where they are properly located.

Method

Top-working is done by budding and grafting. The method of budding has already been described under budding. The advantage of grafting over budding lies in the fact that it may be done in February when the pruning is done rather than in August when the budding must be performed.

Fig. 1. Shows How Trees Are Topped and Budded with Fine Sorts. Shows also how the name of the variety budded is marked on tree.

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Both the cleft and whip graft are used, the cleft graft being employed on large branches while the whip graft is used for small twigs. The work should be begun at the top of the trees and progress downward. All cut and split surfaces should be waxed.

Cost of Trees

It pays to start with good trees. These should be secured from reliable nurserymen whose prices are generally reasonable. The cost per tree ranges from 50 cents to $2 according to size. The advantage in securing the higher-priced budded or grafted tree over the seedling lies in the fact that with the former they will come into bearing at least within five years (often in three) from the time of planting, whereas the tree from the seed will generally require from 12 to 14 years, and may never bear. Again, there is always uncertainty as to the size of the nut the seedling will produce.

The man with limited capital should begin in a small way with the best trees. He should plant seed nuts from thrifty trees to be used as stocks into which the buds or scion wood from his few standard trees can be inserted. This is a slow method, but a sure one as the grower knows exactly what to expect. A part of each year's growth of the standard trees can be cut for bud wood or scions without detriment to the trees and this surplus can be readily sold to nurserymen where the varieties can be guaranteed. Supplying this wood from excellent trees is very remunerative.

Planting

Nursery trees are generally sold according to their height, running from one foot up to ten feet. The experience of the older growers is that the three to five-foot trees come out better than the higher trees. Often the tree is small through being stunted. Such a tree will seldom recuperate and should be thrown out at once. This also applies to the orchard, and where one is noticed growing very slowly it should be immediately replaced

with a thrifty tree. Again we find that there is often a too rapid growth, such as eight to ten feet in a season. Buy one-year budded or grafted trees on two to four-year roots.

The nurseryman usually prunes the root at the proper place in digging the trees. However, the cut may not have been made smooth and this should be examined when the trees are ready for planting.

Two-year taproots should be cut back from 18 to 20 inches. Four to five-foot trees should have about 10 inches removed from the top and those of other sizes should have their tops and roots cut proportionately. This cutting back of the top is done to balance the loss of the root system which is made at the time of digging the trees. Some take trouble to dig out holes 4x4 feet in setting the pecan. This is hardly necessary although plenty of room should be given the roots, which

Fig. 2 When Gov. Hogg, of Texas, was on his death bed he requested that pecan trees be planted on his grave, and the nuts distributed to the school children, to be planted. This tree bore the second year after planting and has borne each year since.

when pruned take up more room than any other trees from the nursery.

For Methods of Planting, see under *Apple*.

The surface soil should be used for filling, and where this is not rich it will be well to thoroughly mix about one pound of commercial fertilizer to the soil which is used in filling the hole. Never let the young tree roots get dry, and after planting if there should come a drought, water should be given to them. Too little attention is generally given to the planting of all fruit trees. It is one time when the quickest way is by no means the best. The care will have to be given for the first two years.

Young trees show a smaller percentage of loss than older ones going through the transplanting process, and they are much more easily handled. It takes the trees some little time to readjust themselves. A loss must be expected in transplanting. All the young trees will not start off simultaneously. Some will soon start out a vigorous growth while others will be more backward. Some may take another year to die. Here then is the necessity for expert care and nursing if the trees are in the early stages of their orchard life. A mulch of leaves or straw should be placed around the tree to prevent evaporation.

Time for Setting Trees

The fall is the best time for this. Dormant trees set in the fall establish themselves through the winter and are ready in the spring to push out their buds. From the latter part of November to the first of February is the best time for Gulf states. The earlier in this period the better.

Cultivation

When the growth starts in the spring, the soil should be plowed and leveled, this to be followed by a shallow cultivation every ten days, until July 10th or 15th. The light harrowing should be practiced, following rains, as soon as the ground can be worked. Where the harrow does not reach the hoe should be employed. Bearing orchards should have

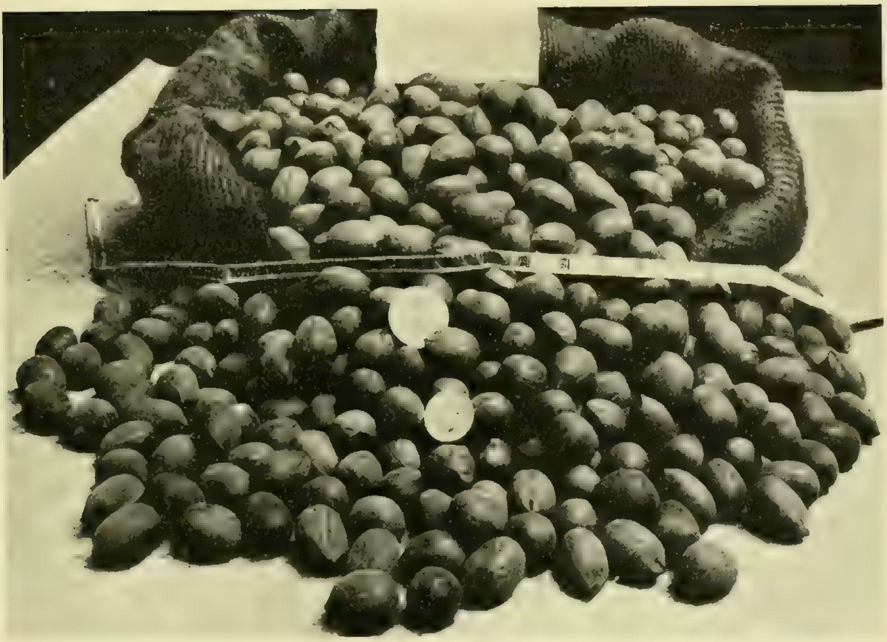


Fig. 3. Olivier Pecans.

cow peas or velvet beans planted between the rows.

The following varieties are recommended by the American Pomological Society. Districts 4, 5, 6 and 7 (See page 1161) mainly comprise the Southern states. An asterisk signifies that a variety does well; a double asterisk, very well, and a dagger, "recommended for trial."

Varieties of Pecans

NAME	Description				Recommendations for the several districts. For location of districts see P. 129			
	Origin	From	Size	Quality	4	5	6	7
Alley						†		†
Centennial	La	ob	vi	vg			*	*
Curtis						†		†
Delmas								*
Frotscher (Frotscher Egg Shell, Olivier)	La	ob	l	vg	†	**	*	*
Georgia (Georgia Giant)								†
Hollis (Posts Select, in part)								†
Jewett	Miss	o	vl	vg				†
Money Maker								*
Pabst								*
Peerless								*
Post (Posts Select, in part)								†
Rome (Rome, Columbia, Columbian, Pride of the Coast, Bourgeois)							*	†
Russell	Miss	ob	l	vg			*	*
San Saba	Tex	o	m	vgb			*	*
Schley					†	**		*
Stuart (Castanerd)	Miss	rob	l	vg	†		*	**
Success								*
Teche (Frotscher, of some)						†		*
Van Deman (Paragon)	Miss	ob	l	vg	†	**	*	*
Young								*

Key.—Quality: b, best; g, good; v, very.

Time of Bearing and Yield

Seedling trees especially are often intermittent bearers. The main crop is heavy about every third year. The standard varieties often have better years than others. There are several reasons for this. Frosts may occur at the blooming period, also heavy rains and high humidity may prevail at the same time. If the trees pass through a drought all the energy is necessarily directed to the maturing of the present crop. The formation of buds for the next season's crop must suffer. The pecan demands a constant, regular supply of moisture, and without it we must expect irregular crops. Some years the insect pests are more troublesome than others.

Ninety per cent of the trees which fail to mature profitable and regular crops may be traced to the selection of improper varieties, to trees improperly planted, and to the trees being improperly cared for after planting.

It will take from 8 to 12 years to bring an orchard into commercial bearing. There is a Mobile tree on record which produced 20½ pounds the fifth year after planting. Much depends on the variety, the soil and its treatment and the management of the orchard. A tree from 4 to six years old comes into bearing and from 8 to 10 years will be profitable, and between the ages of 12 to 15 years should bring a net income of $100 per acre. Ten to 25 acres of pecans should produce a good living; 100 or 200 trees properly cared for and planted on congenial soil will be far more profitable than ten times as many trees not properly cared for.

Cracking the Pecan

For table use the pecan is readily cracked and the kernels extracted with the use of the common two-handled cracker which can be secured at the stores for 25 and 30 cents. By grasping the pecan firmly in the hand and crunching down on the ends of the pecan snip off these ends first. Then place the nut longitudinally in the cracker and just press sufficiently to crack the shell. Then turn the nut and crack it once more. When this is practiced a few times there will be little difficulty in removing the kernels either whole or in halves. For candies, cake, etc., the housewife will find this method a great time saver. In snipping off the ends care should be taken not to endeavor to remove too much shell, as in a well-filled nut the ends of the kernel will be broken, spoiling the appearance of them. It is better to take a little time and not try to get into the tempting kernel too quickly. Cracking the nuts in the hands or placing them in the cracker either sidewise or lengthwise generally results in picking out irregular-shaped pieces which taste just as good but are unfit for the candies.

A well-filled nut is less apt to retain the "peel" which tastes so bitter. This clings to the sutures of the poorly filled nut and helps to score against it.

There are numerous devices for extracting the kernels of pecans, one of which is a small vice with cup-shaped caps. The pressure on the nut generally splits the shell in the center and the two halves are pulled apart. With some varieties this device works very well.

Pecans as Food

Many years ago, before the study of human foods took its true place as a thing to be considered in the economy of nations, the value of foods was a matter of conjecture. Now scientists can tell a man with a perfect digestion almost to a grain what nourishment he will get from any given food. Among the surprises that food chemists have given the world none are of more interest than those that relate to the value of nuts as a food. Every one has heard of lost persons existing for many weeks on the nuts of the forest, but the average mind until a few years ago associated them only with the joys of circus day or the delights of a winter night before the fire. Now we know that they are more than condiments or accessories to the menu and must be regarded as very real foods. Indeed, bulk for bulk, nuts are among the most nutritive foods that we possess. All nuts yield high food values, and when properly eaten or pre-

pared may to a large extent form a substitute for meat, because they contain much protein and fat in small bulk.

Among the nuts that yield the greatest amount of nourishment pecans stand almost first.

Edible Portion of Nuts—Per Cent

	Protein	Sugar Starch	Carbohydrate		Mineral Matter	Water	Fuel value per pound
			Cellulose	Fat			
Pecan	12.1	8.5	3.7	70.7	1.6	3.4	3.300
Chestnut	6.4	41.3	1.5	6.0	1.4	43.4	1.140
Cocoanut	6.6	13.7	8.9	56.2	1.6	13.0	3.805
Peanut	29.8	14.7	2.4	43.5	2.2	7.4	2.610
Almond	21.4	13.8	3.0	54.4	2.5	4.9	2.895

Their great food value lies largely in the abundance of fatty matter. In fact, there is no other vegetable substance in all the world's food supply that is so rich in fats as the pecan. There is on old English saying that "No man need starve on a journey who can fill his waistcoat pocket with almonds." If that can be said of almonds it can surely be said of pecans, whose fuel value, compared with almonds, is 33 to 29, or 13.8 per cent more.

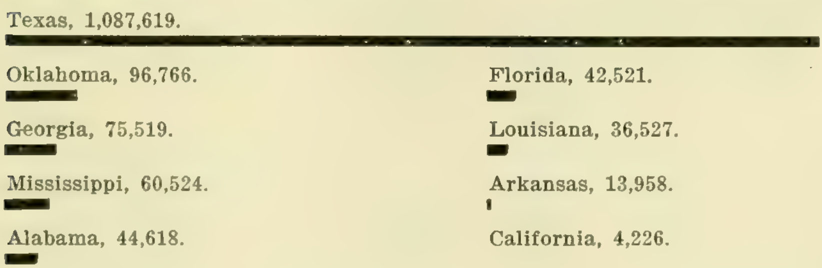
While the nutritive value of nuts is high, it cannot be said that they are as easily digested as many of our other common foods. One reason for this is their high percentage of fat. It has been estimated that one ordinarily large pecan contains as much fat as would be absorbed by two dozen well-cooked doughnuts.

Another reason is because of their dense, compact structure. This can be overcome, either by thorough mastication or by grinding, as for nut butter or nut flour. Still another reason is that their nourishment is very concentrated. For example cheese contains 35 per cent water, eggs 68.2 per cent, lean beef 75 per cent, bread 39 per cent, and pecans only 3.4 per cent. These figures show how condensed the food is within the shell of the pecan.

W. N. Hutt,
Raleigh, N. C.

Pecans in the United States

While pecans will grow in most of the states of the Union, yet they are grown for commercial purposes in but few sections of the country. The following states, with the number of bearing trees in each, were reported in the census of 1910:



Pecans, Profits from. See *Alabama*.

PECAN DISEASES

Frozen Sap Blight

This term has been applied to the injury done by frost to one-year grafts. Generally a dead spot appears in the trunk of the trees. Three and five-year trees are killed by this freezing. These four to six inches in diameter generally stay dormant. In grafted trees buds have been successfully inserted about one foot above the ground.

Pecan Leaf Blight

Cerospora halstedii

This disease of pecan leaves causes them to turn brown, wither up and drop prematurely. At first, small brown spots are noted. These become larger, and at length the whole leaf is destroyed. When attacked by this disease, the tree makes no progress. An examination of the discolored areas, under the microscope, shows the presence of tuft-like growths of spores upon short conidiophores. As they become matured, the spores are scattered by the rain or wind, and so the disease is spread. It probably lives over from one season to another on the diseased leaves.

This disease is essentially a trouble found among nursery seedlings and the author has not noted its doing serious damage elsewhere. After the trees are grafted or budded, they do not appear to be affected by it. The destruction of the leaves of the seedlings interferes seriously with their growth, and it is best to protect them against injury by spraying with Bordeaux mixture. The first application should be given just when the leaves are expanding, and as each new set of leaves starts out, another application should be given. The 4-4-50 Bordeaux formula has been found very effective.

A power sprayer which will cover four rows is most economical, if large areas are to be sprayed. Sprayed seedlings will make practically double the growth of unsprayed.

H. H. HUME,
The Pecan and Its Culture.

Rosette

This is undoubtedly the result of an unbalanced condition of the tree which is not able to properly assimilate its food. It is not a bacterial disease, as plant pathologists have never been able to inoculate the germs into an uninfested tree successfully. It is found in both wild or native trees and the budded and grafted varieties.

In appearance it resembles a miniature shrub rising from the branch of the tree. The stems and leaves in the cluster are small and delicate.

Scab

Fusicladium effusum Wint.

Some varieties are more susceptible than others and when it shows up badly in an orchard the trees should be topworked to a more resistant variety.

Scab causes circular black spots on the leaves which fuse together. It also attacks the young twigs. It appears to attack the trees worse which are in low ground and is most injurious during very wet seasons. There has not been enough work done to determine the best dates for spraying. The difficulty arises in the irregular blooming, causing several sprayings to be necessary in a mixed orchard.

P. F. WILLIAMS,
Auburn, Ala.

Winter-Killing

Trees which have a thick rough bark generally escape from this. It has been avoided by planting seedlings in bottoms and top-working them when five inches in diameter. Four-inch trees do not winter-kill. In trees in which the sap rises first there is the greater danger.

PECAN PESTS

APPLE TWIG BORER. See *Apple Pests*.

CASE WORM. See *Pecan Bud Worm*, this section.

COTTONY CUSHION SCALE. See *Orange Pests*.

Fall Web Worm

Hyphantria cunea Dru.

An insect that becomes, at times, a very serious pest to pecan trees by eating the foliage is the fall web worm, so called. This is the insect that builds so many large and unsightly webs on many forest trees, notably persimmon, hickory, wild cherry, ash and others. According to

Howard it feeds upon 120 different species of forest trees, ornamental trees and fruit trees. The fall web worm is widely distributed, being found all over the eastern and central parts of the United States, and as far west as Texas and Montana.

Adults

The adult insect is a beautiful, delicate moth with wings expanding an inch or an inch and an eighth.

Natural Enemies

Mantis

Among the best friends of the fruit growers and general agriculturist are the insects variously known as the "devil horses," "mule-killers," and "praying mantes." The eggs are laid in large white masses usually stuck to branches of trees. The "devil horses" live upon the caterpillars of the web worm and destroy numbers of them.

Wheel Bug

This is another common insect that preys upon the web worm caterpillars. The wheel bug is so called because of the toothed prominence on its back that resembles half a cog-wheel. The larvae, which are bright red, and the adults are all carnivorous and destroy even more of the web worms than the devil horses.

Stink Bugs

These bugs are familiar to most of us because of their unpleasant odor. This is especially noticeable, sometimes, upon berries, for these bugs leave a strong trail wherever they travel. One of these, known as *Podisus spinosus*, preys upon the web worm and should be carefully protected.

An Egg Parasite

Although the eggs of the web worm moth are very small, there are some insects small enough to live within the eggs and devour the contents. In some cases, whole batches of eggs have been found parasitized by this tiny insect. The name of this small but efficient parasite is *Telenomus bifidus.*

Parasites on the Caterpillars

There are also a few small insects that are parasitic on the caterpillars. These insects deposit their eggs on the caterpillars and the larvae live within the caterpillars, eventually killing them.

Remedies

Owing to the fact that the caterpillars feed in groups, they may be easily reached and destroyed with considerable efficiency. Perhaps the most effective remedy for this insect in small pecan orchards or where a small number of trees is concerned is to destroy the caterpillars by burning them when they have collected together within their webs. This may be done by any efficient form of torch fastened to the end of a long pole. A bundle of rags or a porous brick saturated with kerosene oil and wired to a pole is as good as any. Care should be taken not to burn more of the foliage than is necessary. During the fall and winter months the cocoons of the web worm may be collected in quantities and destroyed. Finally, there are the arsenical poisons.

Hickory Shuck Worm

Grapholitha caryana

Sometimes pecan nuts are attacked, as they approach maturity, by a small white caterpillar, which mines its way through the shucks of the nuts. This caterpillar is the hickory shuck worm, the larva of a small moth.

But little is known of its life history, and, until more is known of its habits, the best advice that can be given is to gather and destroy the infested nuts by burning them.

Pecan Leaf Caterpillar

Datana angusii G. & R.

Datana integerrima G. & R.

Perhaps the most serious enemies of bearing pecan trees are the two species of insects named above. They are better known than most of the other pests. Both of these caterpillars are very much alike in appearance and very likely both of them are taken for one and the same insect. Prof. H. A. Morgan reports the second one named as occurring in abundance on pecans in Louisiana. From our observations we believe the species *angusii* to be most abundant in Mississippi.

Habits and Injuries of the Pecan Leaf Caterpillar

The caterpillars are one and a half to one and three-quarter inches long, with enough soft, dirty-white hair on their bodies to be called hairy. Their bodies are dark colored and marked with two prominent white lines on each side of the body. The other longitudinal lines have become very faint. The caterpillars, in their growth to maturity, shed their skins several times and change in color during these molts. Just after the fourth and last molt the head and body are light red but soon turn dark. The caterpillars have the curious and interesting habit of leaving their feeding places in the branches and crawling down the trunk of the tree, where in a close mass they shed their skins for the last time. The masses of cast-off skins may be seen clinging to the tree trunks late in the autumn.

When very young, the caterpillars eat on one side of the leaf only, but as they grow and molt they begin devouring the whole leaf, except the large ribs, and later these are also eaten, thus completely destroying the leaf. Young pecan trees are often completely defoliated by this caterpillar.

The caterpillars, like those of the fall web worm, feed in colonies but do not spin large, conspicuous webs. As they near maturity they may be seen wandering singly over the trees, but this is only for a very short time. After the larvae have crawled down the trunk and shed their skins for the last time, they crawl back up the tree and feed for a little while and then each caterpillar starts down the tree trunk to enter the ground to pupate. They go into the earth to a depth of four or five or even six inches, form a small earthen cell and there change to pupae.

Eggs

The eggs are laid in batches of 400 to 800 or even more on the under side of the leaves. This habit is very similar to that of the fall web worm. The eggs of the pecan leaf caterpillar are at first of a light green color but later become perfectly white. They hatch in five or six days.

Larvae

Already described. The caterpillars take about three weeks to complete their growth.

Pupae

As already stated the pupae are formed in the ground and the summer broods remain there about two weeks, while the fall brood remains there all winter.

Adult

The adult moth of *Datana integerrima* has a wing expanse of one and three-quarter inches. It is buff in color and the fore wings have four brown transverse stripes on them.

Remedies

Whenever eggs are found they should be destroyed unless we are sure they are parasitized. If they are infested with parasites, they should be left alone in order that the parasites may develop.

The caterpillar may be destroyed in considerable numbers, if watched rather closely, when they descend the trunk to cast their skins. Of course they will by this time have done most of their feeding, but nevertheless it is important that they be destroyed in order to prevent a larger future brood.

Finally, there remains the application of some arsenical poison.

Live-Oak Root Borer

Mallodon melanopus Linn.

The larvae of this beetle are very common as borers in certain parts of the south, especially in Georgia and Florida, on roots of the live-oak. The eggs are deposited in the foot or collar of the tree just below the surface of the ground. "The effect on the tree is to kill the original sapling, which becomes replaced by a cluster of insignificant and straggling suckers, forming perhaps a small clump of underbrush."*

This insect is one of our largest beetles and is from one and three-fourths to two and a quarter inches in length and five-

*Riley. 1884 Rept. Div. Ento. U. S.

eighths of an inch broad. It is dark brown in color with long feelers, or antennae. The larvae or borer that hatches from the egg laid by the parent beetle finally becomes as thick as one's forefinger and nearly three and one-half inches long. It is supposed that the borer lives several years before attaining its growth.

The only thing I am able to suggest as a preventive measure against this insect is to examine the young pecan trees frequently at their bases for the borers and if they are present to dig them out. It may often be possible to run wires into the burrows of the larvae and kill them in that way.

Oak Pruner

Elaphidion villosum Fab.

Although this insect is known as the oak pruner, it attacks many other trees besides the oak.

Where the oak pruner is abundant it is a common thing to find the ground beneath oak trees littered with small branches and twigs that have been cut from the trees by this pruning beetle. It is said that the insect occasionally cuts off branches several feet long; but usually they are from a few inches to one or two feet in length. Within nearly every cut-off branch will be found a soft, white grub living in a burrow that it has made for itself in the hard wood of the branch. This is the larvae of the oak pruner.

Life History

The adult female beetle deposits an egg in a branch of the tree which soon hatches into a small white larva. The larva immediately begins eating the wood just beneath the bark usually traveling toward the base of the limb. Later, it works into the middle of the branch and keeps on eating out its burrow, which sometimes reaches several inches in length. Finally, the larva cuts the wood of the branch all the way around so that it falls of its own weight or is broken off by the wind. The larvae transforms to a pupa in the burrow in the fallen limb. It takes about three years for this insect to complete its growth.

The larva does not always cut the branches off in which it lives.

Food Plants

This beetle has been found to infest a wide variety of plants. Among the list of known species are, the oak, abies, hickory, chestnut, maple, apple, plum, peach, grape, quince, locust, redbud, wistaria, sumach, orange, osage and pecan.

Remedies

Wherever it becomes abundant it may be controlled by picking up and burning the fallen branches.

Pecan Bud Worm

Acrobasis sp.

One of the most serious pests to the buds of pecans is what is known as the bud worm. The larvae is very destructive to newly set spring buds and sometimes to the buds of trees the first year after transplanting. Chittenden reports injury to pecan buds in Georgia, during 1902, by three species of *Acrobasis; rubrifasciella* Pack., *angusella* Grt., and *palliolella* Rag. The following notes on the habits of the bud worm were made by Mr. James Brodie, of Bioloxi, Miss.:

"I found it a very destructive pest among spring buds when I practiced that system of propagating pecans. In spring budding, the buds are placed and forced out the same season, but are generally late in starting—say the end of April or the beginning of May. The moth deposits her eggs just as the bud opens. At birth the larva is small, not more than one-eighth of an inch in length. It secretes itself in the inner folds of the opening bud and begins work. Its presence is apt to be overlooked until damage is done. As the larvae advances in growth it spins a web around the small, expanding leaves, with the evident object of retarding growth of the bud and affording cover while in the pupa stage. When the mischief has been done its presence is easily detected by the blighted appearance of the bud and an accumulation of excreta that entangles in the web.

"The most effective remedy I found was close daily inspection and the removal of the worm on a pin point.

"This same moth frequently attacks the buds of trees the first year after transplanting. Like the spring buds, they are apt to open late and if weakly they are liable to be damaged and the planter discouraged. With sound healthy trees or established summer buds, the case is different. The growth of such buds is well advanced or made before the moth appears and consequently beyond the stage liable to serious injury."

Pecan Catocala

Catocala viduata Guen.

There are often found on pecan trees in the early spring, large, grayish caterpillars ravenously devouring the fresh, tender leaves. Occasionally these caterpillars occur in considerable numbers and their presence is always revealed by the ragged and half-eaten leaves and bare stems. They are exceedingly ravenous feeders and defoliate the trees while in tender leaf.

When disturbed, these caterpillars are very active, squirming and flopping about like a fish out of water.

The full grown larva is from two to two and one-half inches long. The body, in general, is dark, grayish green, with various markings of darker and lighter greens which give it a remarkable resemblance to the bark of the pecan trees on which it is found resting when not eating. The color of the caterpillar presages well the color of the adult.

Distribution

No doubt this insect occurs on the native wild pecans and probably on hickories, which are closely related to the pecan.

Dyar, in his list of the *Lepidoptera*, says it is distributed over the South Atlantic states.

Remedies

Owing to the fact that the caterpillars devour the pecan leaves, they may be destroyed by the application of some arsenical poison, applied at the time the larvae appear.

Pecan Pruner

Oncideres texana Horn

The female of this species severs the pecan twigs, after which she lays her eggs in the cut branches.

Eggs

These are imbedded between the bark and wood in perforations made by the female beetle. The opening is closed by a gummy secretion. The eggs are about two and one-half millimeters in length, of a whitish color, and long, oval in shape. Each egg is laid beneath a bud and rarely beneath a small branch if it be not more than one year old.

Larvae

These are white in color and from one-half to three-fourths of an inch long. They vary much in size.

After hatching they soon burrow a little distance into the wood and remain there until the warm weather. During following spring and summer they excavate galleries in the dead branch just beneath the bark. Occasionally, one is found burrowing in the solid wood. They grow rather slowly and apparently little wood satisfies them.

The larvae exist in these cut-off branches one year in most cases and then pass into the pupal stage within the gallery. Some larvae certainly pass another winter in the branches.

Before the larva changes to a pupa, it cuts a pinhole in the bark near the end of the gallery, and closes up the opening of the burrow behind with long thread-like shavings.

Adults

These are grayish beetles from one-half to five-eighths of an inch long. The male is the smaller and has longer antennae. The antennae of the female are only slightly longer than the body, while those of the male are considerably longer. The wing covers are marked with irregularly roundish, red spots.

Distribution

This species is probably quite widely distributed over the Southern states.

Food Plants

Hickory, persimmon and pecans.

Prevention

This insect can be easily controlled by picking up the severed branches and burning them in the autumn. It must be

remembered, however, that all the branches containing eggs do not fall to the ground. Some are never wholly cut off, but even these topple over and can be easily detected. Others are cut off but lodge in the tree. Care should be exercised to get all the branches—those in the tree as well as those on the ground.

Pecan-Tree Borer

Sesia scitula Harris.

Description

The adult form is a beautiful, clear-winged moth, resembling the parent moth of a peach-tree borer. The moths resemble wasps and, no doubt, are often mistaken for them. The wings are clear and the body and legs are marked with yellow, all of which add to the similarity to wasps.

Injuries of the Pecan-Tree Borer

The peach tree borer confines itself almost exclusively to that part of the trunk just below the ground and to the roots of the peach tree. "Occasionally a borer is found in the trunk above ground." From my observations on the habits of the pecan-tree borer I have come to the conclusion that it invariably works in the trunk and branches above ground, thus differing decidedly from the peach-tree borer.

They are especially injurious to the buds on large trees. That is, where the limbs of a large pecan tree are cut back and then budded, the buds are severely attacked by this insect and in order to save the buds they require constant inspection. In smaller plants very few of the borers are found.

The larvae in attacking a tree select some injured spot or some spot which has been freshly cut, like a newly inserted bud.

Distribution

The species is found in Canada, New England, Middle States to Virginia, and westward to Ohio and Illinois, Georgia and Mississippi, and very likely all the Gulf states.

Food Plants

Dr. Beutenmuller in his monograph records it as occurring on oak, chestnut, dogwood, and probably on hickory and willow. Its favorite food plant seems to be the dogwood.

Remedies

It will be readily seen that the problem of protecting buds from the ravages of these borers is a difficult one. There remains the final remedy of digging the borers out. This is the remedy so universally used against the peach-tree borer. The buds will have to be watched from day to day and the borers removed as soon as discovered.

It is evident from the habits of this insect that special pains must be taken to prevent injury to the trees, especially while cultivating them. The plow, harrow, cultivator and other tools used in cultivation must be kept from knocking the bark off the trees. If the tree is injured the wound should be sealed over with wax or fresh cow manure and bound tightly with rags.

Pecan Weevil

Balaninus caryae Horn.

*With the increase of pecan culture in our Southern states frequent inquiry is made in regard to the cause of the holes in the nuts. The insect involved in these cases is the pecan or hickory nut weevil, a pest which is evidently destined to become one of the principal drawbacks to the cultivation of the pecan. Indeed, in many parts of the South it already divides that distinction with the husk-worm, so that it has been truthfully said that what the husk-worm leaves the weevil detsroys.

The beetle is a uniform dark brown, nearly black, and the scaly covering is hair-like on the thorax, fine and somewhat sparse on the wing-covers, and much duller, with little or no mottling.

The larva is decidedly yellow, having the head bright red and wider than long. Its cervical plate is dark. The pupa is similar to that of the larger chestnut weevil. (*Which see.*)

The distribution extends from New York to the Gulf, and westward at least to Iowa.

* Bureau Entomology Circular 99.

The life history of this weevil, as it occurs in the pecan in the South, is, so far as can be gathered from reports from Georgia and Texas and from laboratory experiments, very similar to that of the chestnut weevils. The female begins to deposit her eggs in August while the pecan is still immature, and the larva usually escapes from the nuts in the latter part of September and in October, but most of them do not issue until the husks open, allowing the nuts to fall.

Remedies

Care in the selection of the site for a pecan orchard is advised. The grower should avoid planting in the vicinity of wild pecan and hickory of whatever kind. The entire crop, also, should be harvested or hogs should be turned in to devour what nuts are left. Where swine and chickens have access to a pecan grove, the ground is well rooted and scratched up, and there is less loss from weevils than in the previous year. Evidently both hogs and poultry devour the larvae in the ground.

Termite. See *Common Termite*, page 550.

Twig Girdler. See *Pecan Pruner*, this section.

Walnut Moth. See *Leaf Caterpillar*, this section; also under *Walnut*.

Pennsylvania

The apple is the principal fruit grown in Pennsylvania, although all the fruits common to the north temperate zone are grown there. In the number of bearing apple trees Pennsylvania ranks third. Missouri is first, with 14,359,673; New York second, with 11,248,203, and Pennsylvania third, with 8,968,937. In the production of apples New York claims first place and Pennsylvania second, and the statistics available to us justify these claims. In the southeastern portion of the state, Pennsylvania touches the sea level, and rises from this point to 3,000 feet in the mountain and plateau region, then slopes off to about 600 feet above the sea along the shores of Lake Erie. Pennsylvania includes a part of the Piedmont section, so famous in Virginia for the production of Winesap and Albemarle Pippin apples. This is a soil formation different from that of any other part of the state, characterized by a red clay and clay loam, sometimes with so much vegetable matter as to make it look like a black loam. It extends along the eastern side of the Alleghany mountains at an elevation of about 500 to 1,000 feet. There are places also where there is a strong proportion of lime in the soil. These are among the most fertile in the state, and, other things being equal, the best adapted to the growing of apples. There is a narrow strip of land along the shore of Lake Erie which is composed chiefly of clay, loam, sand and gravel, derived from the glaciated uplands and deposited beneath the water when Lake Erie covered a much larger surface than it occupies now, and when a considerable portion of land that is now in cultivation was part of the lake bed. These lands in the extreme northwestern part of the state are well adapted to the growing of apples, grapes, peaches, and, in smaller areas, to market gardening.

Pennsylvania is unlike some other states, in that there is no particular part of the state where apples can be more successfully grown than in other parts. In almost all parts of the state there are sections where apple growing can be made profitable. However, the largest apple-producing sections are in the west and southeast. It cannot be said that the business here is more profitable than in other parts of the state, but that there are larger areas adapted to this industry. Susquehanna county, in the northeast, had at the time of taking the 1910 census 208,614 bearing trees; Bedford, in the south, 273,241, and other counties in different portions of the state produce good fruit in abundant quantities.

The number of bearing peach trees in the state is 2,383,027. The counties that produce the largest number of peaches are: Erie, 253,457 trees; Westmoreland, 100,334; York, 92,844; Allegheny, 95,414.

Pears are grown successfully wherever peaches and apples flourish, but the pear

crop of the state is not in any way equal to that of the other two named fruits.

The principal grape-growing section is in Erie county, in the northwestern part of the state, touching the shore of Lake Erie. The whole state reports the number of vines as 5,271,246, while Erie county reports 4,236,332. This report shows that this one county alone produces more than four-fifths of the grapes of the state.

Strawberries are chief among the small fruits, and Erie, York and Allegheny are the principal producers.

Pennsylvania, with its mountain ranges, valleys, lake coast and close proximity to the ocean, has many varieties of soil, climate and conditions for the growing of many varieties of fruits. In the southeastern part of the state the best winter varieties of apples are said to be the Stayman Winesap, Grimes Golden, York Imperial, Nottingham Brown, Fallawater, Gano and Rome Beauty.

In the northwest section the best winter varieties are said to be Stayman Winesap, Grimes Golden, Jonathan, Baldwin, King, Northern Spy, Hubbardston, Rhode Island Greening, Roxbury Russet, McIntosh, Wagener and Aikin.

In the central section the Hubbardston takes first rank, then come the Stayman Winesap, Grimes Golden, Rome Beauty, Jonathan, Mammoth Black Twig, Fallawater, and York Imperial.

In reference to markets, Pennsylvania is very favorably situated. It is as near to New York city as the main body of New York state. It has great trunk lines of railroads leading in all directions and within its own borders is the great city of Philadelphia, with more than one and one-half millions of people.

GRANVILLE LOWTHER

Frost and Precipitation for Pennsylvania

Station	No.	Frost				Precipitation
		Average Date of		Date of		
		First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Erie	1	Oct. 19	April 30	Oct. 12	May 17	39.2
Saegerstown	2	Sept. 24	May 14	Sept. 11	June 2	44.3
Emporium	3	Sept. 29	May 6	Sept. 21	May 29	44.2
Leroy	4	Oct. 2	May 2	Sept. 15	May 29	41.2
South Eaton	5	Sept. 28	April 22	Sept. 6	May 10	38.2
State College	6	Sept. 22	May 12	Sept. 2	June 9	40.2
Selinsgrove	7	Oct. 1	May 8	Sept. 19	June 9	44.1
Mauch Chunk	8	Oct. 10	May 10	....	....	50.5
Pittsburg	9	Oct. 19	April 26	Sept. 25	May 29	36.8
Huntington	10	Oct. 15	May 1	....	....	42.2
Lebanon	11	Oct. 25	April 25	....	....	45.9
Quakerstown	12	Oct. 20	April 20	....	....	45.2
Harrisburg	13	Oct. 23	April 9	Oct. 3	April 26	38.1
York	14	Oct. 1	April 25	Sept. 19	May 10	41.9
Westchester	15	Oct. 26	April 23	Sept. 26	May 31	50.5
Philadelphia	16	Oct. 30	April 8	Oct. 3	April 29	40.6

Production of Fruits in Pennsylvania

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	......	8,678	12,271	13,620,047	$1,175,016
Strawberries	13,515	4,136	5,667	9,033,904	759,154
Blackberries and dewberries	4,892	1,235	1,383	1,063,257	91,007
Raspberries and loganberries	8,990	2,594	3,938	2,906,302	272,337
Currants	5,375	558	716	493,871	42,181
Gooseberries	1,999	139	267	109,104	9,047
Cranberries	55	4	....	5,728	503
Other berries	13	12	300	7,881	787

Strawberries are by far the most important of the small fruits grown in Pennsylvania, with raspberries and loganberries ranking next. The total acreage of small fruits in 1909 was 8,678 and in 1899, 12,271, a decrease of 29.3 per cent. The production in 1909 was 13,620,000 quarts, as compared with 19,261,000 quarts in 1899, and the value $1,175,000, as compared with $1,269,000.

Orchard Fruits, Grapes, Nuts, and Tropical Fruits: 1909 and 1899.—The next table presents data with regard to orchard fruits, grapes, nuts, and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quanttiy of orchard fruits produced in 1909 was 13,286,000 bushels, valued at $8,678,000. Apples contributed about five-sixths of this quantity; peaches and nectarines and cherries most of the remainder. The production of grapes in 1909 amounted to 34,020,000 pounds, valued at $851,000, and that of nuts to 3,796,000 pounds, valued at $90,000.

The production of all orchard fruits together in 1909 was 47.4 per cent less than in 1899, and the production of grapes also declined. The value of orchard fruits increased from $7,976,000 in 1899 to $8,678,000 in 1909, and that of grapes from $640,000 in 1899 to $851,000 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits, and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	....	13,186,773	....	5,921,247	13,285,953	$8,677,986	25,236,854
Apples	188,713	8,000,456	76,841	2,501,185	11,048,430	5,557,616	24,060,651
Peaches and nectarines	80,256	2,383,027	48,599	2,179,386	1,023,570	1,351,175	143,464
Pears	118,593	796,882	50,977	382,180	378,825	356,240	434,177
Plums and prunes	82,758	744,148	38,840	493,601	295,158	396,005	100,210
Cherries	112,165	1,075,031	31,096	280,251	475,093	909,975	474,940
Apricots	4,815	10,363	2,692	7,576	2,502	4,497	1,634
Quinces	44,364	176,849	15,292	77,071	62,350	102,431	(2)
Mulberries	10	17	5	7	25	47	(2)
Unclassified	....	....	....	....	....	....	[3] 21,778
Grapes	84,929	5,271,264	16,055	8,252,811	34,020,198	850,708	47,125,437
Nuts, total	....	[4] 175,457	....	[4] 41,153	[4] 3,795,804	[4] 90,447	5,065,500
Persian or English walnuts	53	198	68	142	4,523	516	....
Pecans	130	554	44	463	14,885	532	....
Black walnuts	13,754	65,075	2,969	22,193	2,162,471	39,306	(2)
Butternuts	2,199	21,387	235	4,230	782,415	9,408	(2)
Hickory nuts	4,654	34,427	428	5,516	593,200	25,348	(2)
Chestnuts	2,343	53,511	408	8,272	233,834	15,185	(2)
Unclassified	....	....	....	....	....	....	[3] 5,065,500
Tropical Fruits, total	....	123	....	60	....	15	....
Figs	26	84	13	38	170	7	....
Japanese persimmons	4	39	2	22	3	8	....

[1] Expressed in bushels for orchard fruits and persimmons, and pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other"
[4] Total includes almonds, Japanese walnuts, hazelnuts, Japanese chestnuts, beechnuts, Italian chestnuts, Spanish chestnuts, filberts, white walnuts and other nuts.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	65,320	29.8	Gals	8,060,914	15,890,868
Vinegar	23,012	10 5	Gals	1,242,246	3,475,206
Wine and grape juice	6,363	2 9	Gals	106,756	194,610
Dried fruits	9,701	4.4	Lbs	285,297	938,810

Peppers

Capsicum annuum

Native of South America. Perennial, but in cultivation grown as an annual. There are many varieties, differing chiefly in the shape of their fruit. All of them have erect, branching stems, which become almost woody. The leaves are spear-shaped; flowers, white, star-shaped, solitary in the axils of the leaves; fruit generally hollow with a somewhat fleshy skin, at first dark green, but when ripe turning yellow, red or dark violet. The seeds are flat, and, like the flesh of the pods, have a very acrid, burning taste, for which the plant is cultivated and used in giving flavor to pickles, etc. Their germinating power lasts about four years after being separated, but if left in the pods they will keep much longer without injury.

Culture

Peppers need practically the same cultivation as the tomato or egg plant, except that they may be planted two feet apart, in rows three feet apart.

Varieties vary much in the shape of the pods and the acridity of their juice. The

Fig. 1. Ruby King Pepper.

kinds most commonly grown are as follows:

Ruby King.—Fruit very large, bright red, smooth, mild flavored and prolific. The best for general use.

S. B. Green,
Minneapolis, Minn.

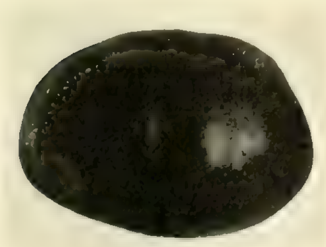


Fig. 2. Tomato Pepper

Other large mild varieties are Squash, Bell, Sweet, Mountain and Golden. County Fair and Kaleidoscope are medium sized and mild. The medium-sized hot varieties are Long Red, Celestial and Oxheart. The small varieties, like Coral Gem, Tabasco, Chili and Cayenne, are very hot.

Fig. 3. 1, Mexican Chili; 2, Chili.

PEPPER DISEASES AND PESTS

Peppers are attacked by diseases and pests which are common on tomato and other related plants. (*Which see.*)

Persimmon

The native persimmon (*Diospyros virginiana*) is one of our neglected wild fruits which has heretofore received but little attention from the fruit growers of this country, although it possesses many desirable qualities which, when brought to a higher state of perfection by selection and cross-fertilization, will certainly cause it to be more highly appreciated by all lovers of good fruit. The general public is quite ignorant concerning its real merits. The fruit is scarcely known except by those who live in sections of the country where it grows wild, and even in these localities but little attention has been given to its cultivation. Recently, however, considerable interest in the persimmon has been awakened. Reports of studies and experiments with persimmons have been made by both the Indiana and Tennessee experiment stations, and

improved native and Japanese varieties are being grown at several other stations. A number of persimmon orchards have also been planted in different parts of the country. The following information regarding persimmons is compiled from bulletins of the Indiana and Tennessee stations.

The persimmon grows wild in nearly all the Southern states and as far north as Rhode Island and the Great Lakes. The trees when grown in the open are usually less than 40 feet in height. In forests however, they often attain a height of 60 feet or more with a trunk diameter of two or three feet. They are very long lived. According to the Indiana station, the opinion held by some that a male or nonbearing tree is needed to fertilize the blossoms of the fruitful tree is erroneous; both sterile and fertile flowers appear on the fertile tree. Occasionally, however, trees are found which do not bear fertile flowers, and of course are worthless so far as the production of fruit is concerned. These trees, however, produce more honey, or nectar, than the fertile ones, as shown by the much greater number of honey-bees which visit these in comparison with the fertile trees.

The fruit in the green or partly ripe state is intensely astringent (puckery) to the taste, but usually loses this property on ripening. It varies in size from one-half inch to two inches in diameter, and assumes a variety of forms. Each fruit usually contains from four to eight seeds, though a few varieties are practically seedless and others contain more than eight seeds. The fruit ripens from August to December. Frost apparently aids in the ripening process of some varieties, but is entirely unnecessary with others, as is proven by the fact that many varieties ripen their fruit in August and September, long before the appearance of frost.

Varieties are not true to seed, and vary as much in this respect as does the apple. Persimmons are usually propagated from seed, the seedlings being budded or grafted with improved varieties. Seed for this purpose is gathered in the fall, treated like peach pits during the winter, and planted in the early spring. The seedlings are allowed to remain in the nursery two years and are budded or crown grafted in the spring. Fall budding and midwinter root grafting have both proved unsuccessful at the Indiana station. Both cleft and whip grafting are practiced, care being taken to cover the cut portion well with grafting wax.

Native seedlings require considerable time before they come into bearing, but when grafted or budded with improved varieties and well cared for they often produce fruit in three or four years from the graft.

Transplanting is best done in autumn. This gives the trees an opportunity to adjust themselves to their new position and the pruned roots time to callous before growth commences in the spring. The long taproot, which is characteristic of persimmons, renders transplanting somewhat difficult. Trees which have been removed once or twice in the nursery, or young trees not more than one or two years from the graft, more readily adapt themselves to this purpose. Ground intended for new orchards should be thoroughly subsoiled to a depth of about eight inches below the roots of the young trees and kept well cultivated throughout the first seasons.

Persimmons do well on almost any soil, from worn-out red clays to the most fertile bottom lands.

PERSIMMONS, PROFITS FROM. See *Alabama*.

PERSIMMON DISEASES

Leaf Blight

Cercospora diospyri Thum.

This disease occurs in Southern states on leaves and fruit of perismmons.

Control

This, in common with related fungi, should yield to Bordeaux treatment.

PETROWSKI TURNIP, value of variety. See *Alaska*.

Philippine Islands

These islands are a governmental dependency of the United States, and comprise the northeastern group of the great archipelago that lies between Australia and eastern Asia. The land area is 128,000 square miles. The larger islands are, Mindanao, 45,559 square miles; Luzon, 43,050; Samar, 5,198; Negara, 4,093; Panay, 4,752. The Philippine Islands are nearly twice as large as the five states of New England, larger than New Jersey, Pennsylvania and Delaware combined, and larger than the British Islands. The interior of the larger islands is mountainous, and some of the high peaks rise more than 8,000 feet above the sea.

The archipelago north of latitude 10 degrees is affected by the trade winds. The southeast monsoon, beginning in April or May, blows for about five months. After a short period of variable winds, the northeast monsoon appears and lasts the rest of the year. Typhoons are originated east or southeast of the Philippines. They are most frequent about the time of the equinox. Their course is westward, sometimes diverging slightly toward the north, and they move at the rate of twelve or fourteen miles per hour. The outer circle of the storm varies from forty to one hundred miles in diameter; the inner circle, or calm, has a diameter of from eight to ten miles.

Up to recent years, hemp, rice, sugar and tobacco were the principal products, but lately considerable attention is being given to other products, among them vegetables and tropical fruits.

The climate is exceedingly mild and even; perhaps no other point in the United States or its possessions shows so little variation. The government thermometer for seventeen years never registered colder than 77 degrees, and the warmest registration was 82.9 degrees. The mean temperature during that period was 80.42 degrees. There are five dry months, in which the total average of rainfall is 5.47 inches. There are seven wet months, in which it is 65.65 inches. An elevation of five thousand feet would give a change in temperature of about 17 degrees. The soils are varied, including clay, sand, slaty, volcanic and alluvial.

All kinds of tropical fruits can be grown and vegetables could be produced in abundance. Among the fruits the banana is grown most extensively, while the plantain, of the banana family, is also grown and the two furnish, together with rice, the principal food of the natives. Oranges, lemons, limes, cocoanuts, guava, breadfruit, custard apple, mango, strawberries, blackberries, and numerous other fruits can be successfully grown. The outlook is that the Philippines will become one of the great fruit-producing sections of the world, for nowhere are the soil, climate and natural conditions more favorable for the production of tropical fruits.

GRANVILLE LOWTHER

PHOSPHORIC ACID. See *Apple Orchard, Fertilization of.*

PICKLE WORM. See under *Cantaloup.*

PIGNUT. See *Hickory.*

Pineapple

The plant belongs to a very peculiar family, the *Bromeliaceae*, and is the most important species in the genus Ananas. In its original distribution the family was confined to the Western hemisphere, mainly to South America, though the genus Tillandsia is represented by a number of species in the Southern states. As a whole, the family is either tropical or subtropical.

* The pineapple is a multiple fruit; that is, the fruit which we know as a pineapple is really an aggregate of many individual fruits, the number of which determines the size of the pineapple. At a certain period in the life of the plant the heart—that is, the last-formed leaves—will assume a bright red color, and instead of more leaves forming, the flower head will appear on a stalk which is a direct elongation of the plant stem. The flower heads are rather conspicuous, being covered with the bright red flower bracts. The flowers, which are inconspicuous, are of a violet or purple color.

*Porto Rico Exp. Sta. Bul. 8.

In developing, the flower head loses its bright red color, and the terminal bracts form the rosette on top of the fruit that is called the crown. Later buds may appear on the stem below the fruit, which develop into slips.

Propagation

A plant bears but one fruit, and the next crop must be produced by a new set of plants. There are several different parts from which the pineapple may be propagated, all of which are quite similar. All are miniature plants, and are known under different names according to their position on the mother plant.

Rattoons and Suckers

At the time the fruit is forming buds appear on the stem among the roots as well as in the leaf axils. These buds develop into individual plants, and those which are formed below the soil are called "rattoons," while those in the leaf axils are called "suckers." Either of the two forms soon develops roots, and as the roots of the rattoon develop directly in the soil, it will soon be independent of the mother plant and can be left to continue the field. The sucker, if left on the mother plant, also throws out roots, but, as it is not in contact with the soil, the roots develop partly around the base of the new plant under the lower leaves and partly in the leaf axils of the mother plant. In that position the sucker will grow and bear fruit exactly as if its roots were taking nourishment from the soil. The nourishment may in this case be taken up by the roots from the leaf axils where they are developing or through the stem by which the sucker is attached to the mother plant. It has been proved that the sucker grows as well after severing the connection with the mother plant as before, showing that the roots are actually taking up nourishment, although not in connection with the soil. The practical importance of this is that where the plants are close enough together to prevent the suckers from being blown over they can be depended on to bear a crop of fruit. Both the rattoons and the suckers can be severed from the mother plant at any time and used for planting.

Slips

The plantlets appearing on the fruit stalk below the fruit are called "slips." They are similar to the rattoons and suckers, but they seldom attain the size of those while attached to the mother plant, and they can not reach maturity and bear fruit without being planted, as they have no chance for root development.

Crown and Crown Slips

The rosette of leaves on the apex of the fruit is called the "crown." This is similar to the slip, and when cut off from the fruit and planted it will grow and produce another fruit.

Frequently, and especially in some of the varieties, a number of slips will be found beneath and around the crown; these are called "crown slips." They are usually small because they do not have time to develop; they can be used for propagation, however, if other slips can not be obtained.

Seedlings

Practically all varieties of pineapples produce seeds. The quantity produced varies in the different varieties and apparently depends on the locality as well as the season.

In propagating from seeds, plant in boxes under cover, use light soil, and cover the seeds lightly. The seedlings are subject to damping off, and it may often be necessary to sterilize the soil before planting. After the plants attain the size of small slips they can be set out in nurseries and later transplanted into the field. Seedlings will bear in from two and a half to three years, while slips bear in about one year and a half, showing that it is not practicable to propagate from seed, but it is of great importance in developing new varieties. The seeds do not reproduce the variety true to name, and in propagating from seeds the result is a number of different types, some of which may be equal to the parent, some inferior, and some superior.

In growing pines, the first consideration is that the plants must be free from disease, strong, vigorous and mature.

Soil and Its Preparation

In Florida most of the pineapple soils consist of over 99.5 per cent insoluble silica or sand of rather coarse texture. Pines can be produced on soils of widely different character, although the best quality of fruit is produced on soils somewhat resembling those of Florida.

The three requirements of the pineapple plant are that the roots must have a limited amount of water, the necessary supply of plant food, and an unlimited amount of air. It will be understood that a well-drained sandy soil in which the individual soil particles are coarse fills some of the requirements. It will need frequent stirring of the top soil until the plants become large enough to shade and protect it from evaporation. The plant food, of course, will have to be supplied.

In clay soil and in loam and even in fine sand the conditions are not so readily controlled. A heavy rain will pack the surface, excluding the air from the roots, and, unless the land is bedded, the water is likely to remain in the soil long enough to cause serious injury to the roots.

Aeration is really the underlying principle of pineapple cultivation. The pineapple plant is not adverse to water, but the water, when filling up the soil, excludes the air.

Methods of Planting

The methods of planting now followed range from single rows, six feet apart, planted on a ridge, to 20 or more rows, 15 to 18 inches apart, planted on level ground. All of the methods have strong advocates, and it is simply a question of which method is best adapted to certain fields, considering all of the factors that can enter into the discussion. Let us first consider a sandy soil, well drained and free from joint grasses. If the sand is comparatively coarse, the ground water not within two feet of the surface, and the lay of the land such that the surface water can drain off quickly, the problem is very simple. Such land should without question be planted in wide, level beds.

If the sand is fine and the drainage not perfect, the soil should be bedded up. The height and width of the beds will depend entirely on local conditions. If there are no noxious weeds to combat, the beds should be as wide as it would be possible to make them and not higher than absolutely necessary to insure good drainage.

In loam and clay soils the considerations are: To keep the soil aerated, to get rid of an overabundance of water in the shortest possible time, to be able to keep the soil free from weeds, and to prevent the fruit as well as the plants and suckers from falling over.

Preparing the Plants

The young plants, whether suckers, slips, or crowns, are covered with leaves to the very tip of the base. In stripping these leaves off and exposing the stem a number of excrescences will be seen, which are the root buds, some of which may be already developed into roots of considerable length. Many planters maintain that it is necessary to trim the plants, that is, to cut the tip of the base and to strip the leaves off for a distance of one to two inches. Other planters maintain that this process is not at all necessary. Why is this?

The reason is simply the difference in local conditions under which the plants are grown. If a slip is planted without trimming in a dry, sandy soil, the roots will form, but instead of spreading out in the normal fashion, they will wind around the stem under the leaves. There are two reasons for this; one is that on account of the dry soil the leaves covering the stem remain hard and dry and the roots would have to overcome great resistance in order to penetrate them; they therefore follow the course of least resistance and develop under the leaves. The other reason is that the plant catches a great deal of dew and water from light rains, which is retained in the heart and leaf axils, from which it trickles down around the base and makes the condition there favorable for root formation, while at a distance of an inch or more from the stem the soil is drier.

This growing of the roots around the stem is called in Florida "tangleroot,"

and there plants are trimmed in order to insure the desired root development. If the plants are set in a loamy soil or clay soil that contains considerable moisture, the leaves covered up with soil will decay in a short time, and as the soil is as moist a distance away from the plant as close by, the roots will spread out just as well as if the plants had been trimmed. Therefore for planting in a dry soil or in a dry season, trim, but for planting in a moist soil or in the rainy season the work is not worth the cost.

The trimming consists in cutting off the base and stripping off the lower leaves, leaving an inch or more of the stem exposed. If large suckers are planted it is quite common to cut the ends of the leaves off, but this is not desirable, because cutting or breaking the leaves lowers the vitality of the plant.

Cultivation

On account of the shallow root growth and the close planting, cultivation is confined almost entirely to hand work. With the single-row or narrow-bed system some horse work can be done the first season, but after that the leaves interlace and with horse cultivation more or less damage is caused by breaking and tearing the leaves. The extent of the damage compared with the difference in the cost of cultivating will naturally determine the best method to be employed, but some hand work will always be necessary. On the sandy soils in Florida the scuffle hoe is generally used, but on the heavier soils in the West Indies it is necessary to use the ordinary hand hoe, not alone on account of the heavier soil, but also because of the much more abundant growth of weeds. Wherever the land is weedy, cultivation should be strictly attended to, because a crop of weeds is detrimental to the growth of the pineapple plant; and if left to grow, large weeds are much more difficult to eradicate than if attended to in time.

Varieties most grown in Florida and the West Indies are Cabezona, one of the largest varieties grown; Red Spanish, a small to medium variety, very susceptible to soil conditions.

Gathering

In the picking of the fruit, the method of bedding, the variety, and the size of the plant influence the method used. Pineapples are very susceptible to injuries, especially in the field before curing, and should be handled almost as carefully as are strawberries or ripe avocados.

Because of the spines, the pickers should wear long-sleeved, heavy canvas gloves, and where they must walk through the pines it is also well to have protection for their bodies.

Stiff bushel baskets are best for collecting the fruit. Each fruit should be placed in the basket, not thrown or dropped. The Red Spanish can be broken off its stem by a quick sidewise and downward jerk or by placing the knee against the fruit stalk and giving the fruit a quick jerk across the knee. The Cabezonas must be cut off, since, if broken like the Red Spanish, the stem will break deep into the fruit and decay will soon follow. It is questionable if it is advisable to make more than one grade for shipping.

PINEAPPLE DISEASES

With a soil properly drained and with good culture, few plants are as free from pests and diseases as the pineapple. It is almost axiomatic that trouble with pineapples means bad management. The troubles thus far known are chiefly due to one of three things: First, an ant and its associate, a mealy-bug; second, wilt; and third, spike.

Blackheart

The disease called "blackheart" is due, apparently, to poor soil conditions and lack of proper food. It is characterized by the rotting of the heart of the pine before any sign of affection is shown on the outside. Any puncture or injury of the fruit will admit some of the many fungus spores that will produce rot. This will spread to the center, but it must not be confused with blackheart.

Remedy

The cure, as far as known, is better culture and fertilizers. Phosphates and potash are usually the elements needed, especially the latter. Excess of nitrogen

will produce soft fruits that easily succumb to all such troubles.

Leaf Spot

This is a leaf disease characterized in the first stages by small brownish spots usually not more than an eighth to a fourth of an inch in diameter.

Remedy

Culture and fertilizing have been the most efficacious means of checking it. Plants kept growing thriftily do not feel its effects and soon grow out of it.

Spike or Long Leaf

Characteristics

Any tendency to spike is quickly evidenced by the leaves becoming long and slender. As the disease progresses, the plant becomes more and more like a bundle of rod-like leaves. In the final stages the central leaves of the plant do not unfold, and thus in their long spike-like form give the name to the disease. A plant at all badly affected rarely produces any fruit; if any is formed it is small and practically valueless. Plants that are but slightly affected produce very poor, small-sized fruit.

Cause

In most cases spike is apparently induced by improper fertilizing. Acid phosphate in the fertilizer is one of the most common causes. Wood ashes and any poorly proportioned mineral fertilizer will cause it.

This disease is apparently readily transmitted, and suckers or slips from diseased parents should never be planted. Experiments have shown that fully 70 to 80 per cent of slips from spiky parent plants failed to produce marketable fruits.

Remedies

First, never plant a slip that is in the least affected with the disease.

Second, for nitrogen and phosphorus fertilizers use tankage, dried blood, bone meal, or other organic forms. If necessary to use acid phosphate, give a good application of lime, 300 to 500 pounds per acre, shortly afterward.

Sun Scald

Sun scald is not strictly a disease, but is common and causes so much loss that it is well to consider it here. It is caused by the bending over of the plant so that one side of the fruit is exposed to the direct sun rays. Through moisture adhering to the fruit the action of the sun's rays produces premature ripening and scalding at this spot. Rot soon develops in this scalded part and the fruit is lost. This can be largely prevented by sending boys through the patch every week to put a small handful of dried grass upon every fruit that has fallen over.

Tangleroot

Tangleroot is characterized by the roots winding round and round the stem instead of passing out into the surrounding ground.

Cause

It is caused chiefly, if not entirely, by one of two things: Hard soil, or the slip not having been stripped before planting. In heavy clay soils the ground will often be allowed to become hard. As the young roots are tender and have not much penetrating power, they will follow the line of least resistance.

Remedy

The cure is simple; keep the ground in good cultivation, and if conditions are not very favorable when planting strip the plants.

Wilt

The disease known as wilt is quite easily recognized, and if taken in time may be controlled. Apparently it is transmitted from one generation to the next, so slips from infected plants should never be chosen. According to the best information obtainable, the disease is a fungus one, but it acts in a way not clearly understood, and should be met with extreme measures at its first appearance.

Characteristics

Usually the first sign of the disease is a loss of color, the leaves changing from green to red, then yellow, and finally brown and withering. The withering begins at the tip as a rule, and as it passes down the leaf loses its stiffness and drops, producing the wilted appearance which gives the disease its name. If the attack

is not too severe the plant may produce a fruit, but it is usually of poor quality and ripens prematurely.

Cause

It is often impossible to tell just how the trouble starts, as it may break out simultaneously in widely separated places. It can probably exist in the soil under some conditions for long periods, and it may be carried from plant to plant by ants and other insects. Its presence is usually due to faulty soil conditions, though Australian investigators claim that it also occurs where a field is cropped too long, and by adhering to one source for supply of plants, as well as poor cultivation and fertilization.

Remedies

The first precaution to be taken is one of prevention. Never plant a slip that could possibly be already diseased. Second, if the disease should appear, pull out all plants affected, burn them on the spot, or cover with quicklime; also cover the soil with lime and leave exposed to the sun for a few weeks, stirring it from time to time. After a month or six weeks strong, healthy plants may be reset in the vacant places. Third, keep the plants growing vigorously and the soil in the best possible physical condition.

PINEAPPLE PESTS

Mealy Bug

This pest is easily controlled by sprinkling tobacco dust in the crown. The tobacco dust acts also as a stimulant to the plant.

Pineapple Scale

Diaspis bromeliae Kern.

General Appearance

The outer shells or scales of the females are thin, circular and nearly pure white in color, with exuviae yellow. The bodies proper are yellow or orange, sometimes with blue or purple tints.

Life History

The females usually attack the leaves into which they burrow and may become almost entirely hidden under the epidermis. The fruit is also infested.

Control

Spraying when the pest occurs in the field with kerosene emulsion and resin wash offers effectual control.

E. O. Essig

Plant Lice

*NATURAL ENEMIES OF PLANT LICE

Aphis Lion, or Green Lace Wing

Chrysopa californica Coq.

One of the most common insect predators, working on all sorts of soft-bodied species, is the common green lacewing, called aphis lion, because of its destructiveness to all plant lice. The eggs, larvae, pupae and adults are to be found everywhere in the fields, woods and orchards. In the citrus orchards of Southern California they are very abundant and play an important part in the control of many bad pests, but more important in keeping down the aphids.

Eggs

The eggs are very small, pearly white in color, oblong in shape with the base drawn out to connect with a fine hair or pedestal which supports it nearly half an inch above the surface to which the hair is attached. The egg itself is not more than an eighth of an inch in length. The adult insect has no doubt employed the method of placing her eggs on long stocks for the purpose of putting them out of the reach of other crawling insects which would otherwise devour them.

Larva

When first hatched the larva is of course very small, but grows rapidly. When first born they vary from a light yellow to a gray color. As soon as it leaves the egg the search for food is begun and apparently there are few insects which escape its appetite. At first only the very youngest plant lice are devoured, but it is not long before insects twice and sometimes three times as large as the lacewing are destroyed. The full-grown larvae varies from half to nearly an inch in length, is bright yellow with dark red markings. The head is equipped with a large pair of mandibles, grooved on the inner side, curved like a sickle and

*E. O. Essig. Cal. Com. Hort. Vol. 1, No. 10

pointed. With these it penetrates the body wall and sucks out the contents through the grooves. The legs are short with sharp claws to clasp firmly the footing it may have in order that it may, as is its habit, lift the prey bodily into the air, where its struggles are in vain, and hold it there until all the body juices have been extracted. So fierce are they that they devour not only mealy bugs, the larvae of ladybird beetles, but their own kind.

Pupa

When fully developed and ready to undergo transformations the larva spins a thin, hard-walled, globular pupa case about itself in some crack or crevice and remains dormant for some time. These globular pupa cases are often nearly covered with long white filaments—not unlike cotton—by which they are fastened, and are grouped together in small lots or may be single.

Adult

The adult insect is from five-sixteenths to three-eighths of an inch long and twice as long including the length to the tip of the folded wings, of a beautiful green color with a longitudinal dorsal yellow band extending from the front of the head to the last abdominal segment but one. There are four large, membranous wings, wonderfully nerved (from which comes the name lacewing), and bright, transparent green. The head is yellow above, green beneath, and amber or brown on the sides. The thorax and abdomen are green except the dorsal yellow band. The wing veins and the entire body are covered with fine hairs.

Ladybirds or Ladybugs

Coccinellidae

This family of insects, with but few exceptions, is predaceous, that is, it lives by preying upon other insects. The life histories of the various members of the family are so similar as not to require separate treatment.

The eggs of the ladybird beetle are laid in clusters not unlike bunches of cigars stood on end, and may be found almost anywhere, from board fences to the various parts of the foliage of a tree. They are small, pointed at both ends, and salmon colored. The eggs of one variety *Scymus sordidus*, are deposited singly and are difficult to find.

The larvae as soon as they emerge from the upper end of the eggs begin their search for food, which consists of very small insects at first. They grow very fast and develop tremendous appetites. The body is long, very rough, hairy and dark with red or yellow markings on the back. They have six legs and are capable of traveling very rapidly. As soon as fully matured they hang themselves up by the tail-end to some twig, leaf, limb, or any other convenient place of support and transform into the pupal stage. These pupae may be seen almost anywhere in the orchards. They are reddish brown or grey with dark markings. When touched or disturbed they will suddenly throw up the head as if to strike the assailant. From this stage emerges the adult beetle, which produces more eggs and begins another life cycle.

Red Ladybird Beetle

Coccinella californica Mann.

A scarlet-red beetle very common throughout the state of California. Its head and thorax are black but the wing covers are bright orange or red with a dark spot at the middle base. It feeds on many varieties of aphids.

Black-Spotted Red Ladybird

Hippodamia convergens Guer.

A red beetle with twelve black spots on its back. Head and thorax are black, with white margins and small white spot at base of thorax. The wing cases are very dark to light red, each with six black spots. They are a quarter inch long by three-sixteenths inches wide. The larvae when fully developed vary from a quarter to nearly three-quarters of an inch long. They are dull black with bright orange or yellow markings on the back. The pupae are amber or reddish-brown with transverse dark bands across the body and numerous dark spots on the back.

In the state of California this species has become a very important factor in the control of aphids of various kinds, and especially the melon aphis in the southern part of the state. The superintendent of the state insectary sends his men up into the mountains where the ladybirds gather in the autumn for their winter sleep to locate the colonies as they begin to assemble. Later when the snow has covered them up these colonies are dug out, the beetles are sifted out of the pine needles and other rubbish and sacked up. They are then carried out on the shoulders of men to some central point where they are loaded upon pack animals and transported, literally by the ton, to the state insectary and put in cold storage to await the spring. From the insectary they are sent out at call all over the state to hold in check the rising horde of plant lice.

Ashy Gray Ladybird

Coccinella abdominalis Say.

This ladybird gets its common name from its color, which is gray with eight black spots on each wing cover and seven on the thorax. The larvae resemble those of the red spotted ladybird, *Hippodamia convergens*, but are a little larger with light or yellow spots on the back instead of orange.

This insect is an enemy of the various plant lice which are pests of the orange, but is of special value as a control for the walnut louse, which it prefers to all other species of aphids for food. Its importance can hardly be overestimated.

Scymnus sordidus Horn

This is one of the smallest of the aphid feeders. The larva is considerably larger than the adult, being nearly a quarter of an inch long and half as wide. It is easily recognized by the heavy coating of rather long white, cottony wax and is often mistaken for the mealy bug. The adult is scarcely more than an eighth of an inch long and two-thirds as wide; light brown to very dark brown in color and with elongated body.

This insect is a native of California and is especially abundant in the southern citrus counties, where it also does good work on the citrus mealy bug.

Syrphus Flies

Common names: Flower flies, honey flies, sweat flies.

Always among the plant lice are to be found greenish, flat, sticky-looking "worms" which are decidedly pointed at one end and which do not have distinct head, eyes or legs. These so-called "worms" are the larvae or maggots of a two-winged insect or fly of the order *Diptera* and the family *Syrphidae.* The larvae vary from the minutest first-hatched maggot to nearly an inch in length, according to the species to which it belongs. They are usually light or dark green, but some may be brown, orange, very light or nearly black. The mouth is situated at the small end and all of the food is obtained by puncturing the body walls of the lice and then smoking out the contents. This operation is easily observed in the field. The maggot, firmly supported by the large posterior end, raises itself up and begins to blindly move its mouth-end about in quest of

The Large Syrphid Fly
A, larvae; B, puparium, from which adult has emerged; C, adult.
—*After Essig*

food. If it touches a plant louse it immediately raises it into the air and sucks it dry. This is very rapidly repeated with very disastrous results to the lice. When the larva is full grown it seeks some sheltered spot in which to pupate.

The adults are very swift fliers and are often mistaken for bees. They are common around flowers, feeding upon the nectar and from this habit get the names "flower or honey flies." They are sometimes called "sweat flies" in the Eastern states. Their eggs are deposited singly upon leaves and twigs which are infested with plant lice.

Among the more familiar species of syrphus flies are the following: *Lasiophthicus pyrastri* Linn. This is one of the largest species. It has a yellow face with eyes dark red to brown, thorax irridescent green or blue, abdomen velvety black. Widely distributed.

Syrphus americanus Wied.

Somewhat smaller than *L. pyrastri*, though similar in form and color, except that the abdomen has three broken bands of yellow along the sides. Reported from nearly every section of the country.

Allograpta obliqua Say.

This species is only a quarter of an inch in length. The body is dark and very slender. Eyes dark red. Face yellow. Thorax irridescent green. Abdomen dark with four transverse yellow bands on the back and yellow markings at the base of the ovipositor. Not so widely distributed as the others.

Internal Parasites

*Ichneumon Fly, Chalcis and Ensign Flies

A membranous winged insect of the same general family as the bee, wasp and ant, parasitic on various pests such as aphids and certain kinds of caterpillars. The females of some species are supplied with sharp ovipositors with which they puncture the body walls of their victims, laying their eggs within the living tissues, where larvae hatch and feed, causing the death of the host. Sometimes the eggs are laid on the outside of a caterpillar, and when the larva hatches he bores his way down into his host.

*For technical description see California Horticultural Commission, Vol. 1, No. 7.

The enemy of the aphid is one of the smaller ichneumons. It punctures the louse with its sharp ovipositor and lays its eggs. When the grub hatches it feeds upon the body of the aphid until the latter dies, when it slits a hole in the under wall and glues the mummy to the leaf with a sticky substance. It then uses the body wall of the aphid for a pupa case and undergoes its transformation, and when ready to emerge cuts a round hole in the upper side and makes its escape a full-grown fly, ready to do more damage in the plant-louse world.

Ichneumon Fly

The infested lice may be recognized by the inflated appearance while the bleached mummies still adhering to the leaves and stems of aphid-infested plants are mute witnesses to the effectiveness of their parasitic enemy.

There are several species, and widely distributed.

Chalcis Fly

These flies, of which there are several species, are mostly minute insects, usually black with a metallic luster, though some are yellow.

These flies prey upon many varieties of insect pests, scales, aphids, caterpillars and various larvae such as those of the cabbage butterfly. For the most part eggs are laid within the body of the food insect, where the young larvae develop at the expense of the host.

PLANTING TABLE

Usual Distances Apart for Planting Fruits

Apples	30 to 40 feet each way.
Apples, dwarf	10 to 15 feet each way.
Pears	20 to 30 feet each way.
Pears, dwarf	10 to 15 feet each way.
Plums	16 to 20 feet each way.
Peaches	16 to 20 feet each way.
Cherries	16 to 25 feet each way.
Apricots	16 to 20 feet each way.
Nectarines	16 to 20 feet each way.
Quinces	8 to 14 feet each way.
Figs	20 to 25 feet each way.
Mulberries	25 to 30 feet each way.
Japanese persimmons	20 to 25 feet each way.
Loquats	15 to 25 feet each way.
Pecans	35 to 40 feet each way.
Grapes	8 to 12 feet each way.
Currants	4 x 5 feet.
Gooseberries	4 x 5 feet.
Raspberries, black	3 x 6 feet.
Raspberries, red	3 x 5 feet.
Blackberries	4 x 7 to 6 x 8 feet.
Cranberries	1 or 2 feet apart each way.
Strawberries	1 x 3 or 4 feet.
Oranges and lemons	25 to 30 feet each way.

Distances Recommended for Orange Trees in California

Dwarfs, as tangerines	10 to 12 feet.
Half-dwarfs, as Washington navel	24 to 30 feet.
Mediterranean sweet, Maltese blood, Valencia.	24 to 30 feet.
St. Michael	18 to 24 feet.
Seedlings	30 to 40 feet.

(Bailey's Rule Book, pp. 112, 113.)

Number of Plants Required to Set an Acre of Ground at Given Distances

	Plants
1 ft. x 1 ft.	43,560
1 ft. x 2 ft.	21,780
1 ft. x 3 ft.	14,520
1 ft. x 4 ft.	10,890
1 ft. x 5 ft.	8,712
1 ft. x 6 ft.	7,260
1 ft. x 7 ft.	6,223
1 ft. x 8 ft.	5,445
1 ft. x 9 ft.	4,840
1 ft. x 10 ft.	4,536
1 ft. x 11 ft.	3,960
1 ft. x 12 ft.	3,630
2 ft. x 2 ft.	10,890
2 ft. x 3 ft.	7,260
2 ft. x 4 ft.	5,445
2 ft. x 5 ft.	4,356
2 ft. x 6 ft.	3,630
2 ft. x 7 ft.	3,111
2 ft. x 8 ft.	2,722
2 ft. x 9 ft.	2,420
2 ft. x 10 ft.	2,178
2 ft. x 11 ft.	1,980
2 ft. x 12 ft.	1,815
3 ft. x 3 ft.	4,840
3 ft. x 4 ft.	3,630
3 ft. x 5 ft.	2,904
3 ft. x 6 ft.	2,420
3 ft. x 7 ft.	2,074
3 ft. x 8 ft.	1,815
3 ft. x 9 ft.	1,613
3 ft. x 10 ft.	1,452
3 ft. x 11 ft.	1,320
3 ft. x 12 ft.	1,210
4 ft. x 4 ft.	2,722
4 ft. x 5 ft.	2,178
4 ft. x 6 ft.	1,185
4 ft. x 7 ft.	1,556
4 ft. x 8 ft.	1,361
4 ft. x 9 ft.	1,210
4 ft. x 10 ft.	1,089
4 ft. x 11 ft.	990
4 ft. x 12 ft.	907
5 ft. x 5 ft.	1,742
5 ft. x 6 ft.	1,452
5 ft. x 7 ft.	1,224
5 ft. x 8 ft.	1,089
5 ft. x 9 ft.	968
5 ft. x 10 ft.	871
5 ft. x 11 ft.	792
5 ft. x 12 ft.	726
6 ft. x 6 ft.	1,210
6 ft. x 7 ft.	1,037
6 ft. x 8 ft.	907
6 ft. x 9 ft.	806
6 ft. x 10 ft.	726
6 ft. x 11 ft.	660
6 ft. x 12 ft.	605
7 ft. x 7 ft.	888
7 ft. x 8 ft.	777
7 ft. x 9 ft.	691
7 ft. x 10 ft.	622
7 ft. x 11 ft.	565
7 ft. x 12 ft.	518
8 ft. x 8 ft.	680
8 ft. x 9 ft.	605
8 ft. x 10 ft.	544
8 ft. x 11 ft.	495
8 ft. x 12 ft.	453
9 ft. x 9 ft.	537
9 ft. x 10 ft.	484
9 ft. x 11 ft.	440
9 ft. x 12 ft.	403
9 ft. x 14 ft.	345
9 ft. x 15 ft.	322
9 ft. x 18 ft.	268
9 ft. x 20 ft.	242
10 ft. x 10 ft.	435
10 ft. x 12 ft.	363
10 ft. x 15 ft.	290
10 ft. x 18 ft.	242
10 ft. x 20 ft.	217
10 ft. x 24 ft.	181
10 ft. x 30 ft.	145
10 ft. x 36 ft.	121
10 ft. x 42 ft.	103
10 ft. x 45 ft.	96
10 ft. x 48 ft.	90
10 ft. x 54 ft.	80
10 ft. x 60 ft.	72
12 ft. x 12 ft.	302
12 ft. x 15 ft.	242
12 ft. x 18 ft.	201
12 ft. x 20 ft.	181
12 ft. x 24 ft.	151
12 ft. x 30 ft.	121
12 ft. x 36 ft.	100
12 ft. x 42 ft.	86
12 ft. x 48 ft.	75
12 ft. x 54 ft.	67
12 ft. x 60 ft.	60
15 ft. x 15 ft.	193
15 ft. x 18 ft.	161
15 ft. x 20 ft.	145
15 ft. x 24 ft.	121
15 ft. x 30 ft.	96
15 ft. x 36 ft.	80
15 ft. x 42 ft.	69
15 ft. x 48 ft.	60
15 ft. x 54 ft.	53
15 ft. x 60 ft.	48
18 ft. x 18 ft.	134
18 ft. x 20 ft.	121
18 ft. x 24 ft.	100
18 ft. x 30 ft.	80
18 ft. x 36 ft.	67
18 ft. x 42 ft.	57
18 ft. x 48 ft.	50
18 ft. x 54 ft.	44
18 ft. x 60 ft.	40
20 ft. x 20 ft.	108
20 ft. x 24 ft.	90
20 ft. x 30 ft.	72
20 ft. x 36 ft.	60
20 ft. x 42 ft.	51
20 ft. x 48 ft.	45
20 ft. x 54 ft.	40
20 ft. x 60 ft.	36
24 ft. x 24 ft.	75
24 ft. x 30 ft.	60
24 ft. x 36 ft.	50
24 ft. x 42 ft.	43
24 ft. x 48 ft.	37
24 ft. x 54 ft.	33
24 ft. x 60 ft.	30
30 ft. x 30 ft.	48
30 ft. x 36 ft.	40
30 ft. x 42 ft.	34
30 ft. x 48 ft	30
30 ft. x 54 ft	26
30 ft. x 60 ft.	24
36 ft. x 36 ft.	33
36 ft. x 42 ft.	28
36 ft. x 48 ft.	25
36 ft. x 54 ft.	22
36 ft. x 60 ft.	20
38 ft. x 38 ft.	30
38 ft. x 40 ft.	28
38 ft. x 42 ft.	27
38 ft. x 48 ft.	23
38 ft. x 50 ft.	22
38 ft. x 54 ft.	21
38 ft. x 60 ft.	19
40 ft. x 40 ft.	27
40 ft. x 42 ft	25
40 ft. x 48 ft	22
40 ft. x 50 ft.	21
40 ft. x 54 ft.	20

	Plants
40 ft. x 60 ft	18
42 ft x 42 ft	24
42 ft. x 48 ft	21
42 ft. x 54 ft	19
42 ft x 60 ft	17
48 ft x 48 ft	18
48 ft x 54 ft	16
48 ft x 60 ft	15
50 ft. x 50 ft	17
50 ft. x 54 ft	16
50 ft. x 60 ft	14
54 ft x 54 ft	14
54 ft. x 60 ft	13
60 ft x 60 ft	12
70 ft. x 70 ft	8
80 ft x 80 ft	6
90 ft. x 90 ft	5
100 ft. x 100 ft	4

(Bailey's Rule Book, pp. 117, 119.)

PLANT FOOD REQUIREMENTS. See *Soils*.

Hungarian Prune Yellow Egg Plum

Plums

*The plum belongs to the general genus *Prunus*, which also includes prunes, peaches, apricots, almonds and cherries. Numerous species of plums grow wild in the north temperate zone in both the Eastern and Western hemispheres. There is probably greater variation in the species of plums than in any other of the wild fruits, there being over 100 distinct varieties found north of the equator.

Of all the stone fruits, plums furnish the greatest diversity of kinds. Varieties to the number of 2,000, from 15 species, are now or have been under cultivation. These varieties give a greater range of flavor, aroma, texture, color, form and size — the qualities which gratify the senses and make fruits desirable—than any other of our orchard fruits. The trees are greatly varied in structure, some of the plums being shrubs with slender branches; some species have thin delicate leaves and others coarse heavy foliage. In geographical distribution, both the wild and the cultivated plum encircle the globe in the north temperate zone, and the cultivated varieties are common in the countries of the Southern hemisphere.

The great varieties of plums and the variability of the kinds, seemingly plastic in all characters, the general distribution of the fruit throughout the zone in which is carried on the greatest part of the world's agriculture, and the adaptation of the several species and the many varieties to topographical, soil and climate changes, make this fruit one of much present importance and one of great capacity for further development.

Plum Culture

Propagation

Since plums do not come true from the seed, the usual method of propagation is by grafting upon root stalks. The plum can be successfully grown on a variety of stocks, and for this reason the practices of nurserymen differ, depending upon the cost of the stocks and their adaptability for the purpose.

In the North Atlantic states and New England the myrobalan is the almost universal choice, except for the Japanese sorts, which are worked upon peach roots, especially for sandy soils. This seems to be the practice in the Atlantic states southward to the Gulf, except that the peach is more nearly the favorite. J. W. Kerr (Plums of New York, page 115) says that there are a great many varieties of the *Domesticas* that refuse to unite firmly with the peach. For these the marianna or the myrobalan give best results. For all of the Japanese plums the peach has proved most satisfactory, when the trees are propagated by root grafting on the whole-root plan.

On the Pacific coast the myrobalan and peach are used in about equal quantities, the first named for heavy soil and the latter for the lighter soils. The native plums are not grown in this region.

* Plums of New York

Top-Working

Top-working is not frequently resorted to in the case of plums, but when this becomes necessary the usual methods followed in the case of apples are used. The cleft graft is used in case of larger limbs and the whip graft for smaller ones. For ordinary grafting upon roots, the whip graft is the method used.

The Orchard

Plum trees are set from 12 to 20 feet apart, depending upon the locality, variety and soil. Because of the fact that plums are worked upon different stocks which are adapted to many different kinds of soils it is difficult to describe the one best adapted to the production of plums. Plum orchards carefully managed can be made profitable over practically the area over which apple orchards are proving commercially successful.

Varieties

The choice of variety should be made with reference to the bloom period for any given latitude.

For Bloom Charts, see under *Fruits, Blooming Periods of.*

Of the plums of the Old World the *Domesticas*, *Insititias* and probably the *Trifloras* have been cultivated for 2,000 years or more, while the work of domesticating the wild species of America was only begun in the middle of the last century.

Among those generally grown in the United States are the following:

Prunus americana, in the West Central states north of Missouri, including the varieties Brittlewood, De Soto, Forest Garden, Hammer, Hawkeye, New Ulm, Ocheeda, Stoddard, Surprise, Terry and Wyant.

In the Pacific Coast states, the *Prunus domestica*, *Prunus triflora* and hybrids, including these varieties: Agen, Bradshaw, Columbia, German, Giant, Golden Drop, Golden Prune, Green Gage, Italian, Peach, Pond, Sugar, Washington, Willamette, Yellow Egg Burbank, Satsuma and Wickson.

Pruning the Plum

The habit of the plum to bear early and abundantly under favorable conditions limits its annual growth to such an extent that after the bearing age is attained little annual pruning is necessary other than to remove dead or interfering limbs or to head back an occasional strong shoot which may appear from time to time in the center of the crown.

Dates of Ripening in Yakima Valley

VARIETY	Hanford, White Bluffs and Kennewick	Donald and Parker	North Yakima	Zillah, Granger, Sunnyside, Emerald, Grandview and Prosser	Naches and Selah	SIZE	COLOR
Abundance		8- 1 to 8-28	8- 9			Large	Bright red.
Bradshaw		8- 1 to 8-28	8-20 to 8-26	8- 1 to 9- 1	8-23 to 8-31	Medium	Bluish purple.
Burbank			8-23			Large	Mottled red and yellow.
Combination			7-30				
Damson			8-31			Small	Deep purple.
French prune			8-30 to 9-12	8- 6	8-12 to 9-14	Medium to small	Purple.
Gold			8-31	8-26 to 8-30	9- 4	Medium	Golden yellow.
Green Gage			8-17 to 9-12	8-26 to 9- 1		Medium	Green.
Hungarian		8-16 to 9-13	8-28 to 9-11	8-26 to 9- 1		Very large	Red and yellow.
Italian	8-22 to 9- 6	8-10 to 9-13	8-26 to 9-12	8-12 to 9- 5	8-28 to 9-14	Medium	Purple.
Pacific			8-31		9- 4		
Peach Plum	7-25 to 7-27	8-16 to 8- 2	7-20 to 8- 3	7-18 to 8- 3		Very large	Red and yellow.
Red June				7-18 to 8- 1		Medium	Red.
Silva				8-23 to 9- 2			
Silver prune	8-26 to 9- 6	8-24 to 9- 4	8-19 to 9-12	8-27 to 9-12	9-12	Large	Light yellow.
Shiro				7-18 to 8- 8		Medium	Trans. yellow.
Tenent				8-27		Medium	Blue.
Tragedy		7-26 to 8- 9	8- 3 to 8- 9	7-26 to 9-11	8-10 to 8-12	Medium to large	Purple.
Washington		8- 9	8-26	8-15 to 8-26		Medium to large	Blue.
Wilson			7-26 to 8-21				
Williamette				8-23			
Yellow Egg			8-23	8-10 to 9- 4		Very large	Light yellow.

Plums and Prunes in United States

The number of bearing plum and prune trees in the United States, according to the census of 1910, is as follows:

California, 7,168,705.

Oregon, 1,764,896.

Iowa, 1,155,041.

Texas, 1,020,399

Ohio, 1,001,734.

New York, 919,017

Missouri, 917,851.

Washington, 823,082.

Pennsylvania, 744,148.

Arkansas, 731,276.

Kansas, 624,648.

Illinois, 600,087.

Indiana, 566,988.

Michigan, 464,917.

Oklahoma, 436,421.

Tennessee, 409,627.

Georgia, 357,323.

Kentucky, 355,851.

Nebraska, 351,321.

Idaho, 302,855.

South Dakota, 268,268.

Mississippi, 257,140.

West Virginia, 234,854.

Minnesota, 233,736.

Alabama, 211,991.

Virginia, 171,667.

Louisiana, 149,921.

Colorado, 143,921.

Utah, 135,619.

Wisconsin, 105,909.

South Carolina, 82,212.

Maryland, 69,996.

New Mexico, 51,257.

New Jersey, 46,547.

Maine, 43,576.

Massachusetts, 41,354.

Florida, 39,921.

Vermont, 32,920.

Connecticut, 30,209.

Delaware, 27,115.

New Hampshire, 23,152.

Montana, 21,140.

North Dakota, 19,147.

Arizona, 12,196.

Nevada, 6,716.

Rhode Island, 4,836.

Wyoming, 4,564.

North Carolina, 1,889.

Production of Plums and Prunes

Thirteenth census statistics for continental United States by divisions and states, 1909 and 1899:

In 1909 there were produced in the United States 15,480,170 bushels of plums and prunes, valued at $10,299,495, while in 1899 there were 8,764,032 bushels, value not stated. There was a large falling off in the number of trees of bearing age, those in 1900 numbering 30,780,892, as against 23,445,009 trees in 1910.

Production by Divisions

Of the nine main geographical divisions into which the census divides the country, the Pacific division alone in 1909 produced 12,097,643 bushels, valued at $6,912.825, which was over 78 per cent of the entire crop of plums and prunes in the United States. The Middle Atlantic division ranks second, with 858,274 bushels, $928,673; East North Central, 568,383 bushels, $674,671; West North Central, 499,784 bushels, $535,374; East South Central, 442,125 bushels, $314,199; Mountain, 366,056 bushels, $319,651; West South Central, 327,260 bushels, $267,703; South Atlantic, 257,912 bushels, $236,221; and New England, 62,733 bushels, $110,178.

Production by States

Of the ten principal producing states, California leads all others with a production of 9,317,979 bushels of plums and prunes in 1909, valued at $5,473,539, followed by Oregon with 1,747,587 bushels, $838,783; Washington, 1,032,077 bushels, $600,503; New York, 553,522 bushels, $519-192. Arkansas, Idaho, Michigan, Missouri, Ohio and Pennsylvania, reported a combined production of 1,300.551 bushels, valued at $1,361,554, while the production in all other states amounted to 1,528,454 bushels, worth $1,505,924.

The Tabular Summary

Further details are afforded by the table appended:

Production of Plums and Prunes in the United States—1909 and 1899

DIVISION OR STATE	Trees of bearing age, 1910		Products of 1909		Trees reported June 1, 1900	Products of 1899 (bushels)
	Farms reporting	Number	Bushels	Value		
United States......	1,120,130	23,445,009	15,480,170	$10,299,495	30,780,892	8,764,032
Geographic Divisions:						
New England ...	25,872	176,038	62,733	110,178	177,126	24,976
Middle Atlantic....	148,834	1,709,712	858,274	928,673	1,769,479	428,583
East North Central	299,672	2,739,635	568,383	674,671	3,662,320	596,753
West North Central	253,304	3,570,012	499,784	535,374	3,761,789	428,048
South Atlantic	114,141	1,152,080	257,912	236,221	1,532,414	190,561
East South Central	93,098	1,324,616	442,125	314,199	2,177,474	228,558
West South Central	107,851	2,337,965	327,260	267,703	2,825,796	397,266
Mountain.........	20,616	678,268	366,056	319,651	1,242,413	248,223
Pacific............	56,742	9,756,683	12,097,643	6,912,825	13,632,081	6,221,064
States:						
Arkansas	23,884	731,276	194,649	137,003	1,082,749	174,734
California	18,105	7,168,705	9,317,979	5,473,539	9,823,713	5,632,036
Idaho	6,317	302,855	179,027	132,804	585,173	164,468
Michigan..........	49,498	464,917	181,188	205,765	1,378,952	213,682
Missouri ..	92,163	917,851	234,872	211,472	745,187	111,603
New York.........	62,024	919,017	553,522	519,192	988,147	303,688
Ohio	96,203	1,001,734	215,657	278,505	892,441	81,435
Oregon	18,308	1,764,896	1,747,587	838,783	2,517,523	359,821
Pennsylvania..	82,758	744,148	295,158	396,005	707,512	100,210
Washington ..	20,329	823,082	1,032,077	600,503	1,290,845	229,207
All other states..	650,541	8,606,528	1,528,454	1,505,924	10,768,650	1,393,148

Bureau of Census.

Imports of Plums and Prunes—Year Ending June 30, 1910

	Pounds	Dollars
Europe:		
Austria-Hungary	71,061	4,520
Belgium	1,750	408
France	149,714	17,375
Germany	62,112	18,690
Greece	90	5
Italy	1,068	96
Netherlands	12	3
Spain	1,592	73
Switzerland	......	....
United Kingdom:		
England	...	....
Scotland	....	....
Ireland	....	....
North America:		
Canada	85	7
Mexico	....	....
West Indias—Cuba	1,965	58
Asia:		
Hongkong	6,726	461
Japan	......	....
Total	296,123	41,696
RECAPITULATION		
Europe	287,399	41,170
North America	2,050	65
Asia	6,674	461

PLUMS IN ALASKA. See *Alaska.*

PLUM DISEASES

BLADDERS. See *Pockets*, this section.

BROWN ROT. See *Cherry Diseases.*

CANKERS. See *Apple Diseases.*

CROWN GALL. See *Apple Diseases.*

FIRE BLIGHT. See *Pear Diseases.*

GUMMOSIS. See *Cherry Diseases.*

LEAF CURL. See *Peach Leaf Curl* under *Peach Diseases.*

MILDEW. See *Cherry Diseases.*

Pockets or Bladders

Exoascus sp.

American varieties of plum are sometimes attacked by a fungus related to the leaf-curl fungus. This causes enlargement of the young fruits which are hollow; because of this condition they are sometimes alluded to as "bladders." The conditions which bring about the disease are the same as those of leaf curl, viz., excessive cool wet weather in the early season. The winter spray as for leaf curl should be effective.

FOR REMEDY, see *Leaf Curl*, under *Peach Diseases.*

A. D. SELBY,
Wooster, Ohio.

ROOT ROT. See *Apple Diseases.*

RUST. See *Peach Diseases.*

SHOT-HOLE FUNGUS. See *Cherry Diseases.*

SPOT. See *Apple Diseases.*

SUN SCALD. See *Winter Injury* under *Apple Diseases.*

TWIG BLIGHT. See *Apple Diseases.*

WINTER INJURY. See *Apple Diseases.*

PLUM PESTS

American Silk Worm

Not likely to become important where spraying is done for other pests.

APHIDS. See *Aphids.*

BARK BEETLE. See *Shot-Hole Borer*, under *Cherry Pests.*

BROWN DAY MOTH. See *Prune Pests.*

BUD MOTH. See *Eye-spotted Bud Moth*, under *Apple Pests.*

BUFFALO TREE HOPPER. See *Apple Pests.*

CRICKETS. See *Raspberry Pests.*

Curculio

Conotrachelus nenuphar Hbst.

H. F. WILSON

This insect is one of our few serious pests found native to America, and was one of the first to be written about and recommendations made for control.

So far as known it does not occur west of the Cascade mountains, and it is to be hoped that this barrier will continue to be as effective in the future as it has been in the past. The original food plants seem to be plums and wild crab-apples. At the present time, in addition to these fruits, cultivated peaches, plums, cherries, apricots, apples, pears, etc., are attacked.

The main injury to the fruit is caused by the egg and feeding punctures made by the adults and the work of the larvae in the fruit.

Life History

The insect hibernates through the winter as an adult under boards and trash on the ground and comes out in the spring about the time the buds are swelling and begins feeding and depositing eggs in the fruit as soon as it is well set. Egg-laying may continue for several weeks and the eggs hatch in from three to six days, depending upon the tempera-

ture. The young larva bores into the fruit and feeds around the center until mature, when it crawls to the ground and enters the soil to a depth of several inches, where it pupates. The larval stage lasts from two to three weeks and the pupal stage from two to more weeks. The complete development from egg to adult thus lasts about five or six weeks. After emergence the beetles feed on the leaves and fruit until fall, when they enter hibernation and come out in the spring as indicated.

Remedies

A combination of clean culture and the application of arsenical sprays thoroughly applied are satisfactory in keeping this insect under control.

European Fruit Lecanium. European Fruit Scale. See *Lecanium*, under *Prune*.

Eye-spotted Bud Moth. See *Apple Pests*.

Fall Canker Worm. See *Apple Pests*.

Fall Web Worm. See *Apple Pests*.

Flat-headed Borer. See *Apple Pests*.

Forest Tent Caterpillar. See *Apple Pests*.

Gray Dagger Moth

Apatela interrupta

The caterpillars of the gray dagger moth are often found upon plum foliage in early September. The caterpillars reach full growth about the middle of September and are then about one and one-half inches long. The large, black head is marked with yellowish dots at the sides. About the middle of September, these caterpillars of the second brood spin slight cocoons in any sheltered spot and transform to chrysalids in which state they spend the winter. If numerous enough to require attention, spray with powdered hellebore, or else with Paris green, one pound in 100 gallons of water. Use the milk of lime from two or three pounds of freshly slaked stone lime in the Paris green mixture, to prevent burning of the leaves. Arsenate of lead should be used instead of Paris green on trees that are not carrying fruit.

H. A. Gossard,
Wooster, Ohio.

Green Apple Worm. See *Apple Pests*.

Hop Louse. See *Aphids*.

Leaf Crumpler. See *Apple Pests*.

Lecanium. See *Prune Pests*.

Long-Tailed Mealy Bug

Pseudococcus longespinus Targ.

Pseudococcus adonidum Linn.

General Appearance

The same as the citrus mealy bug in size, shape and color, but is readily distinguished from it by the long white anal appendages as long or longer than the body, from which it gets its name.

Life History

No eggs are laid by this species, the young being born alive. Several generations appear each year; in fact, in Southern California the breeding extends throughout practically the entire year. The life cycle occupies about two months. It is particularly bad in greenhouses and ornamental gardens.

Control

Without doubt the best control measure is the application of a carbolic acid emulsion spray, which should be applied plentifully, from 10 to 15 gallons to an average sized tree, and under a pressure of 200 pounds. The two angle "Bean Jumbo" nozzles on a "Y" to each rod give best results. Large-bodied discs should be used in the nozzles to insure a coarse driving spray.

E. O. Essig

Fig. 1. The Long Tailed Mealy Bug.

Mealy Plum Louse

Hyalopterus arundinis Fab.

General Appearance

The adult lice are long and slender, light green with three darker longitudinal stripes on the back, and covered with a white powder from whence it gets its name. It usually occurs in large colonies on the under side of plum and prune leaves, causing them to turn yellow and drop but not to curl.

Life History

The first broods hatch in the spring from the black, shining eggs deposited upon the twigs of the trees the previous fall by the sexual females. These lice settle upon the under side of the first leaves and bring forth young which soon mature and produce others. During the summer, in July and August, the lice, most of which have acquired wings by this time, leave the trees and feed upon grasses, the fall migrants returning to the trees to give birth to the true sexual winged males and wingless females, which mate—the females laying the over-wintering eggs.

Food Plants

The only fruit trees attacked appear to be the prune, apricot and plum.

E. O. ESSIG

Mottled Plum-Tree Moth

Apatela superans

The caterpillars of the mottled plum-tree moth reach maturity about the middle of September, enter the chrysalis stage, and thus pass the winter. This is a green caterpillar, about an inch long, and is somewhat flattened vertically as if the sides had been compressed. There is a chestnut-colored stripe along the back, margined with yellowish, and on all the segments are shining tubercles, each giving rise to one or more blackish hairs. A few whitish hairs are found on the sides of the body. Remedy same as for the gray dagger moth.

H. A. GOSSARD,
Wooster, Ohio.

OYSTER-SHELL SCALE. See *Apple Pests*.

PLANT LICE. See *Aphids*.

Oyster-Shell Scale.

The Plum Gall Mite

Eriophyes phloeocaptes

Hibernates during the winter in small sub-spherical galls at the base of the buds. A cluster of galls may completely surround the twig. In early spring the mites leave the galls to form new ones. The newer galls are plump and smooth, but the older ones become dry and wrinkled. Prune out the infested twigs before the buds swell and burn them. Spraying thoroughly with lime-sulphur about the time the buds are swelling will doubtless prove a valuable measure against these mites.

H. O. GOSSARD,
Wooster, Ohio.

Plum Gouger

Coccotorus prunicida

During late August and in early September, plums are sometimes found falling as if stung by curculio, but investigation discloses that the pit has been eaten out and that no crescent-shaped cut is shown on the skin of the fruit. Soon after the fruit falls, a small, mottled, brown-snout beetle eats its way out

through the side of the fruit, making a rather large, circular hole. This insect is the plum gouger, *Coccotorus prunicida*. It is slightly larger than the plum curculio, lacks the warts or humps of the latter on the wing covers, and has many short, whitish hairs which give it a pruinose or light-colored, dusty appearance. Until it escapes from the fruit, there is generally no indication of its presence, except possibly a small scar from which the gum exudes. Occasionally a malformed fruit indicates its presence. The pupal stage is passed in the pit and the fruit seldom falls until the beetle is just ready to escape. By far the most effective remedy is to pick and destroy the infested fruit as fast as it falls, because spring spraying is not very successful. Hogs running in the plum orchard do the work very well, but where these animals are not available, or are objectionable, pick up the fruit by hand and feed to hogs, or burn or bury fully two feet deep. The beetle hibernates over winter. This insect is quite injurious in the states further west, but so far as known, it causes little or no damage in Ohio.

H. O. Gossard,
Wooster, Ohio.

Plum Web Worm

Lyda rufipes Marlatt

The gregarious false-caterpillars of a saw fly which web together the leaves of small branches and strip them of all green cellular portions in a very similar manner to the larvae of the cherry-tree tortrix.

Seems to be distributed in Minnesota and the Dakotas northward into Manitoba. Plum trees in Manitoba are reported to have been defoliated one year by them.

The eggs are deposited in close masses along the under side of the mid-rib of the leaf, the long axis of the eggs lying parallel with the mid-rib. The younger leaves are invariably selected, and the eggs laid before the leaves are expanded. Immediately on hatching, the young larvae begin to spin a web and feed through or crawl over to the upper surface of the leaf. As they continue to grow, they travel to other leaves and spread over the whole side of a tree before the insects have become full grown. When ready to pupate the larvae go to the ground and gradually envelop themselves in cocoons, turn to pupea and emerge again the next year in the late

San Jose Scale on Plum Twig.
(Purdue Exp. Sta.)

spring or early summer as mature insects.

As a remedy, plum trees should be sprayed with Paris green or dusted with white hellebore as soon as the webs appear.

RED SPIDER. See *Apple Pests.*

SAN JOSE SCALE. See *Apple Pests.*

SCURFY SCALE. See *Apple Pests.*

SLUG. See *Pear Pests.*

Soft Scale

Control

Same as for San Jose scale.

SPRING CANKER WORM. See *Apple Pests.*

TENT CATERPILLAR. See *Apple Pests.*

TUSSOCK MOTH. See *Apple Pests.*

The Tachina Flies

This is one of the most beneficial families of insects, because of the parasitic habits of the larvae upon destructive caterpillars, grasshoppers, bugs, beetles, saw flies, etc.

The adults are little larger than house flies, being striped and grayish in color with hairy bodies. They are only active on warm days. The eggs are usually white and stuck to the living larvae upon which the coming maggot is to feed. Upon hatching the larvae bore through the

Tussock Moth Tachinid.
Pelteria robusta, Wied.
Parasite of the Tussock Moth, slightly enlarged.

skin of the host, nourishing themselves throughout their development upon the internal tissues, avoiding the destruction of the vital organs until ready to pupate. When the host is destroyed they leave the old carcass and form hard brown puparia near the surface of the ground. The adults issue from these in a very short time. Breeding is rapid, there being several generations each year.

E. O. ESSIG

Viceroy Butterfly

Limenitis archippus

Occasionally the larva of the viceroy butterfly is found feeding on plum leaves, though its normal food is the willow. The larva occurs from the latter part of September until the leaves drop. This species is not apt to become sufficiently injurious to require special attention. Hand-picking and spraying with poison can be resorted to if necessary. The hibernating larvae are easily discovered after the leaves drop and can be collected by hand and burned.

H. A. GOSSARD,
Wooster, Ohio.

WESTERN PRUNE AND PEACH ROOT BORER. See page 1571.

Pomegranate

Punica granatum

The pomegranate is a small tree or bush, a native of Palestine and India. It was well known to the Egyptians and Assyrians and is referred to in the Old Testament. The Greeks and Romans were acquainted with its medicinal properties and with its use as a tanning material.

The fruit of the pomegranate is about the size of an orange and is filled with a great many seeds, which are surrounded by a juicy, acid pulp, greatly prized as a cooling drink.

Pomegranates may be grown in parts of Florida, Alabama, Mississippi, Louisiana, Arkansas and Texas, where the climate is not too cold.

The following varieties are recommended by the American Pomological Society for culture in the above states: Acid, Dwarf, Sweet and Violet.

POMEGRANATES, PROFITS FROM. See *Alabama.*

POMEGRANATE PESTS

BLACK SCALE. See *Apricot Pests.*

CITRUS THRIPS. See *Orange Pests.*

Citrus White Fly. See *Orange Pests.*

Cottony Cushion Scale. See *Apple Pests.*

Florida Wax Scale. See *Orange Pests.*

Greedy Scale. See *Apple Pests.*

Ivy Scale. See *Apple Pests.*

Pomelo. See *Grapefruit.*

Porto Rico

Porto Rico is one of the group of West India islands, and belongs to the United States. It is situated about 1,000 miles from Havana, Cuba; and now that the Panama canal is finished is in almost a direct line with the traffic of the Pacific and the Atlantic oceans, so that it is a convenient coaling station for European-bound ships. Its latitude is about 70 degrees north in the tropical zone. The estimated area is 3,550 square miles. From east to west there is a chain of mountains ranged in two nearly parallel lines, the highest point of which is El Yunque, 3,699 feet above the sea. Between these ridges is a high tableland interspersed with valleys sinking into wide and fertile plains that border on the coast. The eastern and northern slopes, valleys and plains receive an abundance of rainfall for all kinds of crops, while the southern and western slopes are often parched by drouth.

The maximum temperature at San Juan is 99 degrees. In 17 years it has not risen above this, while the minimum during that period has been 57 degrees. The mean temperature for several years past has been from 78 degrees to 82 degrees.

The island is drained by numerous streams and rivers, some of them navigable for a short distance from the coast. It is indented with bays and harbors that make it easy for ships to anchor and attractive to commerce. On the north coast are 17 rivers; on the west, 16, and on the east, 9, besides several freshwater lakes.

The rocks are metamorphic with a strong admixture of limestone, which disintegrates, mixing with the soil and rendering it very fertile.

The principal agricultural products are coffee, tobacco, cotton, sugar-canes and tropical fruits.

The climate of Porto Rico is healthful. The water, gushing from the hillsides, is pure, and the market conditions are often more favorable than those of some of our own states, because the island is nearer Europe.

The fruit industry is as yet undeveloped, but there is every reason to believe that it will become a great producer of oranges, lemons, bananas, cocoanuts and all varieties and kinds of tropical fruits. It is claimed by some, on what seems to be good authority, that Porto Rico is the best pineapple region in the world, while sweet potatoes reach the highest degree of perfection. The industries are mostly agricultural and a large percentage of its arable land is under cultivation. Manufactures are not well developed. On account of the removal of the tariff on Porto Rican products the grower of oranges in that island at this writing has an average of 1 per cent per pound the advantage of growers outside of the United States, and on a crop of 300 boxes, which may be produced per acre, this will amount to about $200. On pineapples the duty is 7 cents per cubic foot, or 35 cents for a standard crate, making a difference of at least $50 per acre. The duty on vegetables is 25 per cent on the listed valuation. There seem to be great opportunities here for the development of the tropical fruit industry, and great wealth is sure to result from proper investments and well-directed labor.

Granville Lowther

Potash. See *Apple Orchard, Fertilization of.*

Potatoes

The potato is the edible starchy tubers of a plant known to scientists as *Solanum tuberosum*, of the night-shade family *(Solanaceae)*. The tuber is usually roundisn or oblong, with a whitish interior and a dark-colored skin.

There has been much controversy as to the origin of the potato. It is conceded that it came from America, but from

what part and when it was first introduced into Europe, and by whom, is difficult to settle among several conflicting claims. It is conceded that the plant grew wild in the Andes mountains, from Chili to Columbia and as far north as New Mexico. Also, Sir Walter Raleigh introduced it into Ireland from North Carolina in 1585-6.

In 1563 John Hawkins introduced it into England from Santa Fe, New Mexico. In 1553 it is said that Hieronymus Cardan, a monk, introduced it from Peru into Spain. For practical purposes it is of little consequence to us now who first introduced it into Europe, although volumes have been written upon this subject. The potato is here and is now one of the staple articles of food for a large part of the civilized world.

Peculiarity of Growth

The potato owes its value to the peculiar habit of developing underground leafless shoots or branches which differ in character and office from true roots, and gradually the swelling at the free end produces the tubers (potatoes), which are the common vegetable food. The nature of these tubers is further rendered evident by the presence of "eyes," which are really leaf buds, in peculiar forms, and which in due time lengthen into shoots and form the stem called the "top." The cause of the formation of tubers is a subject that has been much discussed and is not definitely settled. Professor Bernard claims that it is caused by the presence of a fungus, *Fusarium solani*, which, growing in the underground shoots, irritates them and causes the swelling. The result is that an efficient method of propagation is secured, independently of the seed, which grows on the top of the vine. Starch and other materials are stored up in the tubers for the nutrition of the young shoots and for food. The theory of Prof. Bernard is not generally accepted. The chemical composition of the potato differs as it is grown in different soils, different climates, different degrees of moisture, and on account of different varieties. However, there is an average composition, given by Letheby, as follows:

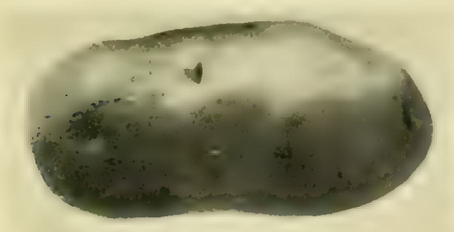
Nitrogenous matters	2.1
Starch	18.8
Sugar	3.2
Fat	0.2
Saline matter	0.7
Water	75.0
Total	100.0

Early Freeman Netted Gem Early Six Weeks Gold Coin

Early Rose. Burbank Early Ohio. Early Bruce.

Propagation

The potato is propagated generally by planting the tubers. The tubers are cut sometimes into small pieces containing but one eye or bud each and planted in rows, either in hills of two to four pieces in a place, or in drills of one in each place and two to four inches apart. They are then covered to a depth of about four inches so that when the tubers form on the root they will be below the surface of the ground, because tubers above ground are green and poisonous. In planting small patches for home use, the planting is done by hand and the tubers covered with a hoe or a plow; but in planting large quantities for commercial purposes the work is done with a potato planter, by means of which several acres can be planted in one day. The seed of the potato, which is really the fruit and which forms on the top, is never planted except for the purpose of propagating new varieties. The largest crops are not likely to come from planting the whole tuber, especially if it is large; neither is it better to cut the pieces too small, for in that case the plant would not have sufficient nourishment to get fairly started; but a medium size of two or three eyes is better. The choice of small tubers is not good, for the constant use of small tubers has been shown to cause degeneration of the stock, or, as the farmers generally say, "the seed runs out."

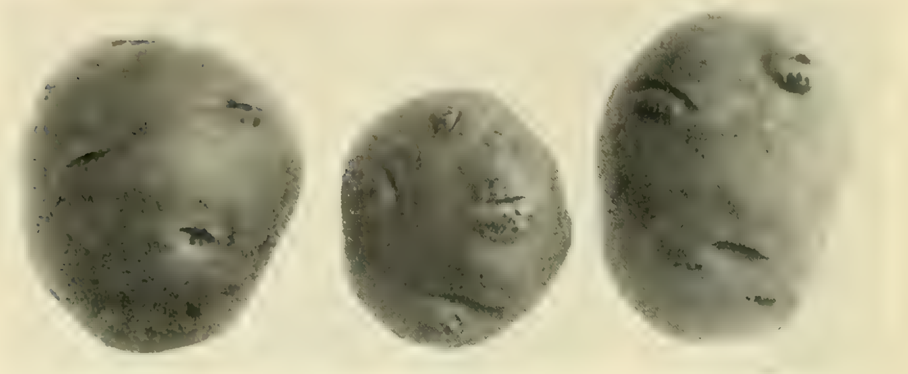


Pride of Multnomah.

Varieties of potatoes grown on the same land and under similar conditions for several years seldom retain their vigor and productiveness. It is better, therefore, to grow something else, like clover, alfalfa, corn or wheat occasionally, and to renew the seed by getting potatoes from another soil and climate.

Soil Best Adapted

We have seldom seen a better soil for the growing of potatoes than the volcanic



Blue Victor. Wee McGregor. Late Rose.

ash of the Rocky Mountain or Pacific Coast states. However, there are parts of North and South Dakota admirably adapted to this crop. In the Eastern and Southern states the sandy soils are considered better than the clays or the black loams. New soil is better than that which has been long in cultivation, and "sod land is also good." The land should not be manured heavily because of the tendency in very rich soil to fungous diseases.

Varieties

There are many popular varieties, some early and some late. Among the good early varieties are the Early Rose and the Early Ohio.

Among the good late varieties are the Burbank, Netted Gems and Rural New Yorker. However, there are varieties better adapted to certain sections than any of those mentioned, and it is better to consult with experienced growers who have succeeded best in order to determine the varieties best adapted to any particular soil, climate or condition.

Salad Potato
Purple in Flesh. Used to Give Color to Salads

Pitting Potatoes

In the autumn if potatoes are grown merely for home use they may be dug and placed in a cool cellar or in pits with straw and earth thrown over them for protection from the freezing of winter. If they are grown for commercial purposes and are to be marketed soon after they are dug they are put into sacks holding 100 pounds in weight. If they are grown for commercial purposes and are to be held until spring for the markets they are generally placed in pits and covered for winter. In all cases where potatoes are pitted there should be some adequate means of ventilation. If the pit is dug about two feet deep, four to six feet wide and long enough to store several tons, there should be an open space in the bottom of the pit by means of two perforated boards nailed together at the edges, making a "v" shape to admit the air the whole length of the pit. In the center and at each end there should be flues or ventilators to admit of the escape of the foul air. The whole system is designed to give sufficient air circulation through the pit to keep the potatoes from becoming stuffy and rotting.

GRANVILLE LOWTHER

Sprouting of Potato Tubers During Growing Season; How to Prevent It

P. J. O'GARA, *Pathologist*

It has been said that "there is no royal road to potato-growing on the Pacific coast," and this saying is decidedly true. While much may be said of the adaptability of many of the commercial varieties of potatoes grown in the East to this district, climatic conditions are more or less responsible for this. Little has been done to originate new varieties of potatoes for our particular climatic conditions, and the experimental work in the acclimatizing of the older commercial varieties so popular under eastern conditions has been very meager. The important matter of potato-growing in our district alone opens up a broad field for investigation, and, if prosecuted as it should, would certainly lead to important results.

It is commonly stated that this district is not a potato district. This statement would be entirely true if certain varieties of potatoes were to be planted and grown under unfavorable conditions. The matter of when to plant for both early and late varieties is a consideration so important that even the most adaptable varieties will not bring results if this one factor is overlooked.

One of the greatest troubles experienced by potato growers is the so-called secondary sprouting, which usually occurs after the tubers have almost reached their full size. Usually this sprouting occurs during the middle of July, or a little later, depending upon the season. Another trouble is the erroneously named "dry rot," which, after all, is not a rot, but rather a browning of the fibro-vascular bundles in the tubers, and is physiological. We shall show that both these troubles are due to very much the same conditions. If there are any unfavorable climatic conditions during the formative period of the tuber, especially about the time the tuber is very nearly full size, either one of the above troubles, or both, are liable to be the result.

Every one has noticed that a tree having its leaves severely injured to the extent that partial defoliation will take place, subsequent sprouting or pushing of the buds, which should have remained dormant until the next season, will take place. For instance, in the East and the South, where the pear leaf blight fungus

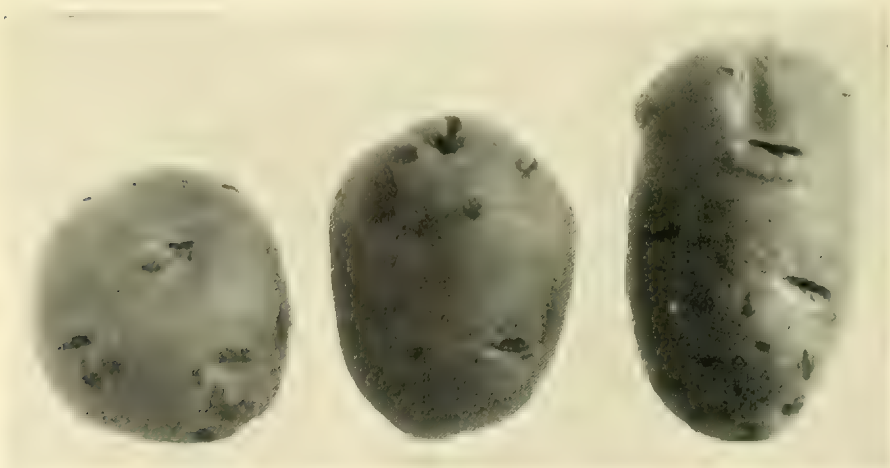
Beauty of Hebron. Early Frazee. Garnichili.

(not pear blight) causes defoliation of the pear trees during the early part of the summer, the fruit buds which have set are caused to come out and a full bloom in the early fall is the result. The attack of the fungus on the leaves causes a premature setting or development of the buds. As climatic conditions following this period are normal to the tree's growth, of course, these newly formed perfect buds will push. But we do not need to go so far as the pear leaf blight of the pear tree for an example. We have even noticed here in this district that trees having their foliage badly injured by insect agencies will also tend to make a late secondary growth. But you will say, "What does all this have to do with understanding the cause of the secondary sprouting of the potato?"

Under our climatic conditions during midsummer all plants transpire very freely; that is to say, they lose water by evaporation through the stomata or breathing pores very rapidly. The higher the temperature and the lower the relative humidity of the atmosphere the greater the rate of transpiration. At very high temperature, say from 90 degrees to 110 degrees, with the relative humidity of the atmosphere 10 to 15 per cent, the rate of transpiration is so great that the roots of the plant cannot take water fast enough from the soil to supply the demand made by the foliage. When this point is reached, injury to the whole plant is the result and there is a tendency to check the growth of the tubers and cause the buds to set prematurely.

It must be remembered that the tuber of the potato is an enlarged underground stem, and the eyes of the tuber are just as truly buds as the axillary and terminal buds we find on the stem above the ground. Now, as soon as normal climatic conditions return, there will be a tendency on the part of the entire plant to resume growth, and the buds on the tuber will tend to push just the same as those on the stem, the result being that both secondary tubers and shoots on the stems will be formed. Under severe conditions it will make little difference whether the plants are well supplied with water or not. It has been noted that this secondary sprouting has taken place even where the potatoes had been well irrigated and where the soil contained a sufficient supply of water. The reason for injury, even where water was supplied artificially, is that the root system, even under the best conditions, could not supply the demand for water made by the leaves.

Since the water stream going upward from the roots through the stem follows the fibro-vascular bundles, it is easily seen that if the injury to the part of the



White Wonder. Peach Blow. Mammoth Pearl.

plant above the ground is considerable, injury will also take place in the bundles of the tuber, the result being that they become brown or discolored. This particular type of injury has been very frequently noted and is spoken of by our English potato growers as "sprain." It is seldom, however, that we notice "sprain" in potatoes that are irrigated in the proper way.

It will be interesting, therefore, to know how we are to avoid these troubles. In the first place, we should avoid such varieties as are particularly subject to the troubles, or at least find some means of growing them so as to avoid the troubles. One of the varieties which seems to be fairly resistant is the Blue Victor. Since we have seen that injury really takes place during the very warm, dry weather in early July, it would seem that by planting the late varieties late so that their tubers will not begin to form well until after these extremely unfavorable weather conditions have passed, we would easily avoid the troubles. There have been some observations along this line which would seem worthy of our attention. In planting the early varieties we should aim to plant them as early as possible so as to have the tubers ripened and ready for market before severe dry weather conditions arrive. Potatoes are by no means the only plants that suffer from high temperatures accompanied by low humidities. The Anjou pear is particularly susceptible to what is often called "tip-burn" of the foliage. Even serious dropping of the foliage may take place. The cause, of course, is primarily due to the fact that the foliage is not properly supplied with water from the root system. Injury may also occur to the fruit. This injury is manifested by a browning or drying of the blossom end of the fruit; for, after all, the fruit is merely a transformed leaf and the tip-burn of the leaf is analogous to the blossom-end injury of the fruit.

The question may be asked why some varieties of plants are subject to this physiological injury and why some are not. This question may be answered by stating that the structures and physiology of the various varieties vary. Certain plants have certain inherent qualities not found in others, such as resistant to drouth, fungus diseases and insect attacks. Even in the human family and in animals generally we find individuals capable of resisting that which others cannot.

Potato Culture

(Adapted to Southern Conditions)

For the best results with this crop the soil should be well drained and should consist of a mellow loam with subsoil of clay when possible. Prepare the land by plowing it good and deep, occasionally turning up a small portion of the clay, then harrow thoroughly. Lay off the rows three and one-half feet apart with a shovel plow and apply the fertilizer by distributing it in the furrows at the amount given below per acre:

	Pounds
Acid phosphate, 16 per cent	425
Cotton-seed meal	500
Sulphate of potash, 50 per cent	170
Total	1,095

The above is approximately an 8-4-10 goods. This should be mixed with the soil by running a scooter point in the furrow. The seed potato should be carefully cut, leaving two or three strong eyes on each piece, being careful to divide the eyes on the little end. Cover the potatoes by running a shovel plow on each side of the furrow. Do not allow rocks or other rubbish to fall on the potatoes. If the ground should become baked, it would be well to run a light harrow over the rows, breaking the crust so the plants will push through.

When the plants are up well cultivate with a five-toothed cultivator and hoe out between the plants, pulling the soil to those that are leaning; also cover roots that are in the least exposed. The

culture should be thorough and care should be taken not to break or injure the roots or underground stems. Repeat the cultivation in 10 days or two weeks. Keep away from the plants, as deep close culture destroys the tubers. Cease all culture after bloom buds begin to appear. At the last cultivation the vines should be hilled up well.

Should the plants be bothered with potato bugs, spray with the following solution:

2 pounds arsenate of lead.
3 pounds pure rock lime.
50 gallons water.

Should the bugs appear in quantities another application of the above solution could be made.

If the vines are affected with blight, spray them with Bordeaux mixture made up as follows:

4 pounds copper sulphate (blue stone).
5 pounds rock lime.
50 gallons water.

The first spraying should be given when the plants are about four inches high and repeat in 10 days to two weeks. To obtain the best results all parts of the vines should be well sprayed, especially the underside of the leaves, and those lying on the ground. Two or three sprayings should be sufficient.

The best varieties for yields are Burbank and Peerless. For a very early crop plant Bliss Triumph or Irish Cobbler. At Auburn, Alabama, we plant March 1st, but the time will vary with the locality.

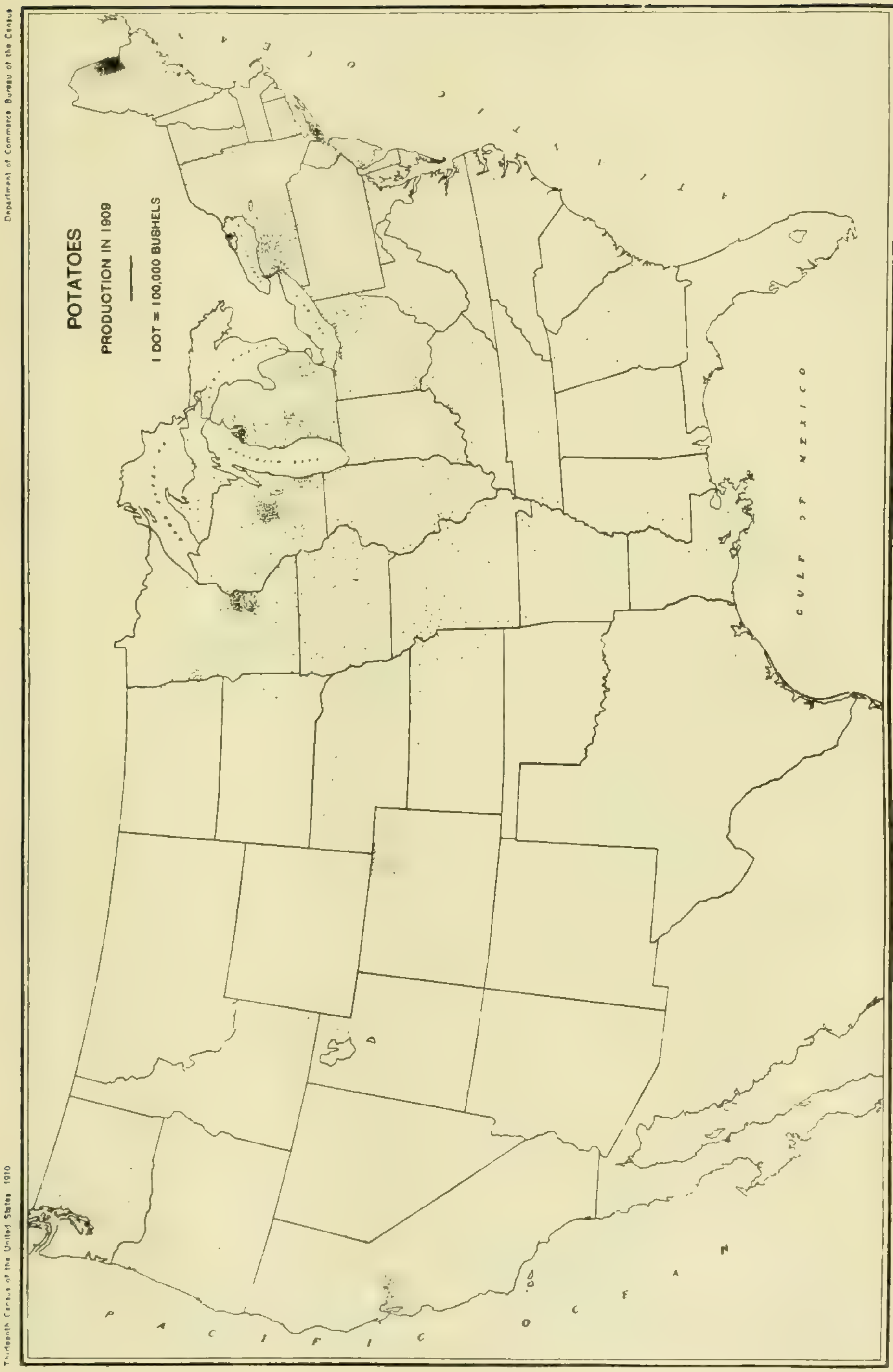
If the potato fields exceed 10 acres in size and help is scarce a machine digger will be found economical. With a five-acre field or larger a power sprayer should be used.

W. P. Williams,
Auburn, Ala.

Potatoes—Acreage, by Divisions and States: 1909 and 1899

DIVISION OR STATE	Acreage	
	1909	1899
United States	3,668,855	2,938,778
Geographic Divisions:		
New England	233,095	180,625
Middle Atlantic	729,323	676,403
East North Central	1,106,032	957,193
West North Central	783,813	637,184
South Atlantic	239,762	157,481
East South Central	119,541	80,138
West South Central	117,761	72,876
Mountain	169,678	80,226
Pacific	169,850	97,252
New England:		
Maine	135,799	71,765
New Hampshire	17,370	19,422
Vermont	26,859	28,353
Massachusetts	24,459	27,521
Rhode Island	4,649	5,816
Connecticut	23,959	27,148
Middle Atlantic:		
New York	394,319	395,640
New Jersey	72,991	52,896
Pennsylvania	262,013	227,867
East North Central:		
Ohio	212,808	167,590
Indiana	99,504	84,245
Illinois	138,052	136,464
Michigan	365,483	311,963
Wisconsin	290,185	256,931
West North Central:		
Minnesota	223,692	146,659
Iowa	169,567	175,888
Missouri	96,259	93,915
North Dakota	54,067	21,936
South Dakota	50,052	33,567
Nebraska	111,151	79,901
Kansas	79,025	85,318
South Atlantic:		
Delaware	9,703	5,755
Maryland	39,299	26,472
District of Columbia	226	194
Virginia	86,927	51,021
West Virginia	42,621	30,123
North Carolina	31,990	23,619
South Carolina	8,610	8,068
Georgia	11,877	8,477
Florida	8,509	3,752
East South Central:		
Kentucky	55,750	37,160
Tennessee	40,963	27,103
Alabama	14,486	9,505
Mississippi	8,342	6,370
West South Central:		
Arkansas	29,719	26,486
Louisiana	19,655	9,220
Oklahoma	32,295	[1] 15,360
Texas	36,092	21,810
Mountain:		
Montana	20,710	9,613
Idaho	28,341	9,313
Wyoming	8,333	2,809
Colorado	85,839	44,075
New Mexico	6,230	1,122
Arizona	1,151	626
Utah	14,210	10,433
Nevada	4,864	2,235
Pacific:		
Washington	57,897	25,119
Oregon	44,265	30,035
California	67,688	42,098

[1] Includes Indian Territory.



Map Showing Distribution of the Potato in the United States and the Relative Production in the Several Sections.

Potatoes—Production and Value by Divisions—1909 and 1899

DIVISION OR STATE	Production (bushels)			Value			
	1899	Increase		1909	1899	Increase	
		Amount	Per cent			Amount	Per cent
United States	273,318,167	115,876,798	42.4	$166,423,910	$98,380,110	$68,043,800	69.2
Geographic Divisions:							
New England	23,466,222	17,779,755	75.8	17,456,938	10,092,191	7,364,747	73.0
Middle Atlantic	64,372,759	14,022,977	21.8	37,292,509	26,608,645	10,683,864	40.1
East North Central	80,988,131	30,618,646	37.8	37,427,211	25,501,069	11,926,142	46.8
West North Central	60,812,316	11,255,235	18.5	30,088,015	15,524,932	14,563,083	93.8
South Atlantic	12,150,748	9,951,882	81.9	14,091,735	6,691,072	7,400,663	110.6
East South Central	5,051,854	4,764,306	94.3	5,940,784	2,647,924	3,292,860	124.4
West South Central	4,867,562	2,546,325	52.3	5,439,504	2,428,721	3,010,783	124.0
Mountain	9,046,736	15,185,373	167.9	8,715,380	3,725,046	4,990,334	134.0
Pacific	12,561,839	9,752,299	77.6	9,971,834	5,160,510	4,811,324	93.2

POTATO, CHINESE. See *Sweet Potato, or Yam.*

POTATO DISEASES

AERIAL POTATO. See *Rhizoctonia*, this section.

Arsenical Poisoning

Spotting and dying of the foliage is frequently caused by the application of Paris green or other arsenical poisons. It is frequently mistaken for blight and injures the plant in proportion as it reduces the amount of green surface. The injured foliage also offers favorable opportunities for the development and spread of the early blight.

Control

Paris green should always be mixed with lime, whether applied dry or in water. It can be applied with Bordeaux mixture without additional lime. Arsenate of lead can also be applied with Bordeaux mixture. The latter spreads and sticks better than Paris green, but acts more slowly.

New Jersey Agricultural Experiment Station Circular 33.

BACTERIAL BLIGHT. See *Black-Leg*, this section.

BACTERIAL ROT. See *Black-Leg*, this section.

Black-Leg

Bacillus phytophthorus
Bacillus solanisaprus

F. D. BAILEY

Black-leg, or black stalk rot, as it is frequently called, is a bacterial disease of the potato which has only recently become widely distributed in this country. It is quite probable that the disease was present in certain potato-raising localities before 1906, but that date seems to furnish the first record of its occurence.

The disease has been known in Europe for a longer period and was recorded in Canada in 1900.

Symptoms

An examination of plants affected with black-leg will leave little chance for confusing this disease with other described potato maladies. The stem and tubers are the parts attacked. The inky black discoloration of the stem at the surface of the ground, from which the name originated, is the most constant character associated with the disease. This blackened area starts at the point where the stem leaves the seed potato; it extends up to the surface of the soil and in some cases may follow the stem several inches higher. The illustration (Fig. 1) shows the result of an artificial inoculation in which the organism followed the stem up to the third leaf.

One who is familiar with this disease can detect its appearance before the blackened area appears on the stem. The whole plant is slightly below normal size, lighter in color, with stems, petioles and leaf blades erect. This condition becomes more acute until finally the plant rots off and dies. The seed tuber is generally affected and in most cases decay starts in it before the plant shows signs of disease.

Cause

The term black-leg is to be considered in a general sense and includes a group of bacterial organisms, all of which have been found capable of producing the disease described under this name. *Bacillus phytophthorus* and *Bacillus solanisaprus*, are two that have been studied perhaps more than any others.

These organisms are capable of causing soft rot when they come in contact with bruised or cut surfaces of the tubers. It is probable that such conditions are essential in order that the bacteria may live over winter. They cannot withstand drying, and in the East it is thought that winter conditions are too severe for them to live over in the soil. It has also been shown that decaying, bruised or cracked tubers will carry the disease over and produce affected plants.

The disease appears early in the season. When plants have lived long enough to form a hard woody stem, this trouble seldom affects them; this may, however, be due to the fact that the organism becomes immediately active and so kills off the plants wherever it has obtained an early foothold. Since it does not spread from hill to hill in the field, no serious epidemic has been known. Wherever loss is caused, only occasional scattering plants are taken; in some cases this amounts to rather a high percentage, however, and should not be overlooked.

Control

Since this bacterial disease does not, to our knowledge, live over in the soil, it must be introduced on the seed. It is not a difficult matter to inspect the seed and discard any that are decaying, bruised or discolored, and this practice should be followed. In addition, use the seed treatment with formalin, as given under potato scab, and you should be able to eliminate this disease.

General Consideration

This disease has not been studied to any extent in the Pacific Northwest, consequently we cannot be certain that the bacteria causing it will not winter over in the soil under our conditions. In fact, our conditions are such that we may find it living for some time and causing more serious trouble here than it has in the East.

Bibliography Black-Leg

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BLACK SCAB. See *Potato Wart*, this section.

Blight or Downy Mildew

This is the most serious pest of the potato and often causes the loss of the whole crop. There are two kinds of blight, both caused by fungi. The early

Fig. 1. This Plant Was Inoculated With the Black-Leg Bacterial Organism.

blight affects the foliage only. The late blight not only kills the foliage but often causes the rotting of the tubers, both in field and in storage. The two forms are treated in the same way. Commence spraying with Bordeaux mixture and arsenate of lead before the disease appears, or about the second week in July, and repeat every 10 to 15 days throughout the season, making about six applications in all. The arsenate of lead is added for the control of the Colorado beetle and may be omitted if the beetles are not present. Thoroughness of application is of utmost importance in spraying for blight, the aim being to cover completely both upper and lower sides of the leaves, and thus prevent the access of the fungus. On large areas where the horse-power sprayer is used this is almost impossible, but where the spray may be directed by hand it is quite possible, and when applied in this way three or four applications during the season will suffice. It is claimed that ridging up the rows after the last cultivation will prevent the disease spores from reaching the tubers and in this way reduce the proportion of rotten potatoes. There seems to be but little difference in the varieties with regard to susceptibility to disease. The earlier varieties, however, often mature their crop before the disease appears.

C. D. Jarvis,
Storrs, Conn.

Brown Rot. See *Black-Leg*, this section.

Canker. See *Wart Disease*, this section.

Downy Mildew. See *Blight*, this section.

Dry End Rot. See *Dry Rot*, this section.

Dry Rot of the Irish Potato Tuber

Fusarium tuberivorum Wilcox

Symptoms

The dry rot here described is a strict tuber rot affecting mature tubers only. Neither the stems nor the young tubers are ordinarily in the least affected. Natural infection is known to occur solely through wounds produced in the process of digging or subsequent handling. In many cases this rot secures a foothold through wounds made by scab-producing animals of certain sorts, and perhaps even through scab spots due to fungus parasitism, though the latter method is certainly very rare, if we may judge from the laboratory experiments. The fungus cannot invade the tuber either about the "eyes" or through the normal lenticels.

The rotting is rather slow, and in general within four to six weeks from one-third to three-fourths of the tuber is destroyed. The epidermis of the rotted portion becomes slightly wrinkled and usually has a characteristic bluish color. On account of the rapid destruction of the underlying tissues the surface over these areas soon becomes distinctly depressed (Fig. 1).

The rot may make its appearance at any point on the surface of the tuber, though more commonly perhaps at the bud end of the tuber. There is no watery degeneration of the tuber unless other organisms gain entrance, so that this is in fact a dry rot.

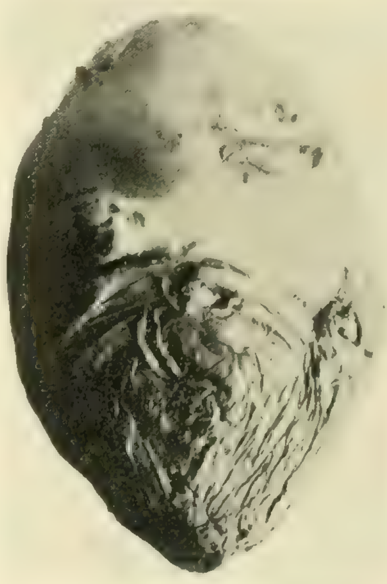

Fig. 1. Dry Rot of Potato Tuber

Cause

Numerous inoculation experiments have shown that this dry rot is caused by a parasitic fungus, for which we have proposed the name *Fusarium tuberivorum*. At the same time it has also been demonstrated that this dry-rot fungus does not cause the injury to the leaves and stems often referred to as "blight" or "wilt." In other words, the present dry rot of the tuber is not connected in any manner with diseased conditions of other parts of the plant.

Methods of Control

Experiments at the Nebraska station in 1912 demonstrated that the disease could be held in check by the use of lime-sulphur wash, boiled in the usual manner in proportions of 5 pounds of lime to 5 pounds of sulphur in 15 gallons of water, formalin dip and formalin vapor. The dip and vapor treatments follow:

Formic aldehyde solution. The tubers were placed in sacks and dipped for two hours in a solution of one pint of 40 per cent formic aldehyde solution (often called "formalin") in a barrel of water. The tubers were then dried before being placed in storage.

Formic aldehyde vapor. The tubers were exposed to the vapors generated by 23 ounces of potassium permanganate placed in 3 pints of a 40-per cent solution of formic aldehyde (formalin) to each 1,000 cubic feet of space.

E. M. Wilcox and G. K. K. Link,
Nebraska Experiment Station Bulletin 134.

Dry Rot or Wilt

Fusarium oxysporum

F. D. Bailey

This fungous disease is both a field and a storage trouble of wide distribution and often causes considerable loss. The trouble has long been known both in this country and in Europe, but little was known until recently concerning the exact cause. In the United States the "dry rot" has long been recognized as a serious trouble; just what the actual loss amounts to it would be impossible to determine. The damage in the field is even harder to estimate, for many times the grower is not aware of any disease or abnormal appearance.

Distribution

In the Northwest the disease is apparently wide spread. Investigations throughout the Willamette valley and lower Columbia basin during the season of 1911 showed very few fields entirely free from the disease. The season of 1912 being exceptionally wet, this trouble seems not to have shown up as extensively.

Symptoms

The wilt disease makes its attack on all parts of the plant below ground. It generally enters through a root and spreads to all other parts beneath the surface.

The first indication of the disease is a different appearance of the foliage. It gradually takes on a lighter color, loses its glistening appearance, and the leaves roll in during the heat of the day. (Fig. 1.) If the plant is attacked while growth

Fig. 1. Wilt of Potato Vine Caused by the Soil Fungus, Fusarium. Dry stem-end rot of tubers is caused by the same organism.

is still taking place, it is quite certain to be dwarfed. The death of the plant comes on slowly and to the casual observer would seem to be little different from the normal maturing. It is premature, however, and the yield is much cut down. It has been shown that the growth in

weight of potatoes, and accordingly the yield, continues to increase at a remarkable rate for every week added to the normal growth of the top. Premature ripening from any cause certainly results in reduction of yield.

As the plant slowly succumbs, owing to the death of the roots, it falls over and can be more easily detected. Such plants pull easily. The roots are easily broken and are often covered with a white or pinkish fungous growth. The main root is discolored; frequently this brown discoloration can be followed along the underground stems into the stem end of the tubers. In this way the fungus enters the potatoes, and, under favorable conditions, it produces the dry stem-end rot. If rot is not produced the fungus can live over winter in the tubers and so spread with the seed potatoes to new fields. Such infected tubers can be detected if a thin slice is cut off at the stem end. If the fungus is present the vascular or fibrous tissue is brown and this tissue spreads so that a ring or a portion of a ring of the brown spots appears on the cross-section at different depths, always following near the surface of the potato. This brown discoloration may follow the fibers back only a very short distance or it may extend very nearly to the apical end of the tuber; in either case it indicates the presence of the disease. In case of rot the fungus does not confine its attack to the vascular tissue but slowly spreads from it through the surrounding tissue, finally breaking it down. As it comes to the surface it breaks through and produces dense tufts of the delicate white fungus.

Cause

The cause of this disease is a soil fungus (*Fusarium oxysporum*)*. It is closely related to the organisms causing the western tomato blight and the wilt of watermelons. It can live for years as a saprophyte, depending on dead organic matter in the soil for food. When potatoes are planted on infested soil the fungus again assumes its parasitic habit and produces disease of the living plant.

* Several other species of Fusaria are known to cause decay of potato tubers.

Like the fungus causing watermelon wilt, this fungus forms small spores which are produced in the vessels of the plant, and larger curved spores on the surface. These larger spores will withstand long periods of drought or cold and germinate when conditions are favorable. They are scattered by wind and insects or at digging time by the implements used in the field.

Control

The fact that this fungus is a persistent soil organism, capable of producing disease whenever potatoes are planted in soil where it is present, makes it necessary to use precaution in keeping the fields free from it.

All seed used should be carefully inspected. It would be a simple matter if, at the time potatoes are cut for seed, a thin slice be cut at the stem end and any tubers that show brown discolorations of the fibers be discarded. In case infected seed is found it will be advisable to use in addition, the formalin seed treatment as for potato scab. This will dispose of spores which may have collected on the surface. It will not, however, serve to disinfect potatoes which show the brown discoloration of the vascular tissue.

Decaying potatoes often carry this fungus to the compost heap, either directly or through being fed to stock. Such practices are to be avoided. Also avoid cultivation or travel from diseased fields onto new land or land where the disease does not exist.

Where the fungus is once established in a field, practice long periods of rotation, preferably to cereal crops. It may be found possible to develop a potato that will be resistant to this disease. There is evidently a varietal difference in this respect, and in time a strain may be developed through processes of selection and breeding which will prove highly resistant.

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Internal Brown Rot

Internal brown rot is the name given to a disease which has recently appeared in a few potato-growing sections of this country. It is first noticed by the darkening more or less of the starchy portion of the tubers, without any manifestation of its presence on the outside; later on the potato rots. The life history of this disease is not known, nor are any remedies known for it. Ordinary prudence, however, would indicate that seed potatoes in the least affected with this trouble should not be planted.

Early Blight

Alternaria solani (E. & M.) Jones & Grant

Early blight of potato is a premature spotting and dying of the potato leaves, due to the work of a parasitic fungus. The occurrence of the early blight is liable to be influenced by the general vigor and other conditions of the plant; yet there is no just basis for denying, in the light of our present knowledge, the parasitic nature of this disease. Jones has made cultures of the fungus and produced the disease by inoculation (Vermont Experiment Station Bulletins 24 and 28; Report 1892) and has secured most admirable results by the use of fungicides. This successful spraying in itself is in the nature of proof of parasitic character.

Control

Spray thoroughly with Bordeaux mixture, adding arsenites for the insects, as required.

There is real danger of the confusion of early blight with the Fusarium blight described elsewhere in this section.

Late Blight of Potatoes

Phytophthora infestans

F. D. Bailey

The disease of potatoes commonly known as late blight or downy mildew is almost universal in extent and has caused more loss than all the other pests of this crop combined. In New York state it has caused a loss of $10,000,000 in one year and an estimate for the United States places an annual loss at $36,000,000.

The outbreak of blight in Ireland in 1845 is often spoken of as the starting point, but, as a matter of fact, records show that it originated in Chili, the home of the potato, and was introduced into the United States, near Boston, as early as 1840. In Australia and Tasmania the invasion has been more recent, probably in the present century.

In the Northwest we have no record to show when the disease first appeared. It is certain that it has appeared occasionally in the coast region for years. The season of 1912 was unusually favorable to it and the fungus rapidly spread and damaged late potatoes throughout the lower Columbia and Coast region. The large acreage planted made the loss in some cases quite serious.

Symptoms

The leaves are the first point of attack when the disease is spreading in the field. Spots appear on any part, more often near the tip or margin; these affected areas spread rapidly until the entire leaf is blackened and dead. As the spot spreads, the margin is changed to a light green and is watery in appearance, often a fine white down can be seen, generally on the lower surface. Drought or unfavorable temperature will check the growth of the fungus, but if the mean daily temperature ranges between 70 degrees

Fig. 1. Late Blight of Potatoes. At this stage the tops appear very much as though frosted.

and 74 degrees, with an abundance of moisture, it will rapidly change the entire top into a moist, putrid mass and sweep over large fields in a few days. (Fig. 1.)

The damage resulting from the loss of the tops might not always prove serious, since the outbreak rarely comes until late in the season, but the fungus does not stop at this. The greatest loss may result from the attack on the tubers. Any exposed potatoes are pretty certain to become infected by the numerous spores formed in the spots on the leaves, and if rains come many spores are washed into the soil and reach many potatoes below the surface. Rot follows and spreads in the hills. At digging time some of the infected potatoes are pretty certain to go into storage with the sound ones, and, if storage conditions are not properly watched, the entire lot may rot.

The tubers, when first affected, show slight depressed areas on the surface; these areas are dark colored and at first penetrate but a short distance beneath the surface (Fig. 2). This gradually advances into the interior until the whole tuber is decayed. If the soil is wet, the decay is aided by soft rot caused by bacteria, and where a field is affected in this way, the putrid odor of decay may be noticeable for some distance. The white tufts of the fungus on which spores are produced come out on the surface of the tubers when the soil or air is humid, in this way greatly aiding the spread of the disease.

Sometimes dry weather follows a period favorable to the spread of the blight. Under these conditions the fungus advances very slowly in the foliage, producing no spores and seldom spreading to new fields. The tubers which have been infected rot more slowly and take the form of a dry rot.

Cause

At the time of the famine in Ireland in 1845 many ideas and theories were held concerning the cause of the potato blight. Some said it was a direct visitation of Providence, some ascribed the disease to

insects, some thought it due to atmospheric influence or electricity, others said wet weather, and some were right in ascribing it to fungi. Many farmers still believe wet seasons to be the cause of this disease. The wet warm season does not cause the blight, but these conditions are essential to the growth and dissemination of the causal fungus.

The scientific name for this causal fungus is *Phytophthora infestans*. It has been the subject of a great deal of investigation, and much literature regarding it has been published from time to time. The group to which *Phytophthora* belongs shows a great deal of variation. Other more or less common forms which are closely related are the mildew of onions and the one frequently occurring on lettuce.

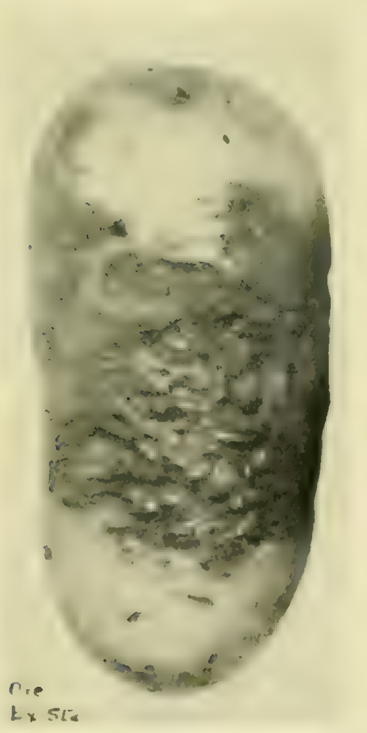

Fig. 2. Early Stage of the Blight on Tuber.

It has been shown by several investigators that the fungus seldom, if ever, runs back from the blighting foliage to the tubers through the stem, but that the spores carry it to the exposed tubers and those near the surface. This same fungus causes a blight of tomatoes (Fig. 3). It is favored somewhat on the tomato by the fact that the fruit is not only easily infected, but also furnishes a great abundance of moisture and food, so that great numbers of spores can be produced. Leaves and stems are also affected.

Treatment

It has been very clearly demonstrated that late blight and the rot of tubers caused by the same fungus can be prevented by proper spraying. Several of the Eastern states have carried on spraying experiments for a number of years, and in every case the results show a marked advantage.

It has been demonstrated that the vigor of the plant is held up in this way and an increased yield results, even when no blight appears.

The only satisfactory spray to use for late blight is Bordeaux mixture. Several applications during the season will be necessary, and the time for spraying will depend on a number of factors, namely, time of planting, weather conditions, and other pests. If the spray is to be put on for blight alone it will be safe to put on the first application when the blossoms of the late plantings are well out, unless rainy weather sets in earlier, in which case spray as soon as possible after the rain. Follow this with later applications every two weeks. The first application should be with 4-4-50 Bordeaux mixture, and the later with 6-6-50. In the case of an epidemic of blight it is necessary to spray oftener, once every week or ten days being advisable.

Other pests, especially flea beetles, require an earlier application.

There is no practical method of seed treatment for this trouble. The fungus is carried over in the seed but under proper storage remains dormant and often cannot be detected. Seed should be carefully sorted so that no decaying or discolored tubers are used in order to secure good germination and later depend on proper spraying to prevent the infection from outside sources.

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Does Winter Kill Potato Blight in the Soil?

*Rotation of crops is necessary to prevent transmission of several plant diseases. Cabbage should not be planted the second year where the first season's crop has shown much clubroot, and potatoes should not follow potatoes where scab has prevailed, nor where Fusarium wilt and its accompanying tuber rot have been destructive.

The most destructive potato disease, however, is late blight, with the common rot that follows it; and questions relating to transmission and control of these troubles are exceedingly important. Does this fungus survive the winter in the soil and make a blighted field of one year unsafe to use the next?

Winter Probably Destroys Phytophthora

Most authorities hold that the fungus causing these two troubles, *Phytophtora infestans*, does not over-winter in the soil; and that there is no more liability to blighting and rotting on a field thus affected the year before than on one free from the disease. Recently two authorities, one in England and one in America, have advanced the opposite view and advise against planting potatoes on soil where blight has been prevalent.

To test the liability to such transmission, the station botanist at Geneva, N. Y., has carried on careful tests in two seasons; and finds no evidence that the fungus can survive the winter in the field in Central New York at least. In each of the tests, soil from a field of diseased potato plants was thoroughly mixed, in boxes, with broken rotten tubers and pieces of blighted stems; and the boxes were exposed to the weather during early winter. Later the boxes were brought into the forcing house, a sound potato tuber was planted in each and conditions made as favorable as possible for growth of plants and development of the disease. In spite of warmth, abundant moisture, both in the soil and in the air, and luxuriant, succulent growth of the plants, not a sign of blighting appeared, even when the plants were grown in a special glass chamber and thoroughly wet daily with water drained from some of the soil mixed with diseased material, or were painted with a thin mud made from such soil.

The results, being negative, do not prove that the late-blight fungus cannot remain alive over winter in the soil, but they make such persistence appear highly improbable.

*Geneva (N. Y.) Bulletin 367.

Depend on Spraying

It would seem unnecessary, then, to change the location of the potato crop to avoid this disease; especially as we know that thorough spraying will control both blight and rot and will increase the crop enough, taking one year with another, to make this a highly profitable regular practice in potato growing.

The spraying of late potatoes should never be neglected.

Leaf Blotch

Cercospora concors

Appears in some of the New England states, but does not appear to be serious.

Leaf Curl. See *Leaf Blotch*, this section.

Leaf Roll

As indicated by the name, leaf roll is marked by an upward rolling of the leaves on their midrib. There is usually a pronounced change in the color of the foliage to a yellow, unhealthy shade, often tinged reddish or purplish.

The disease may start early in summer and be far advanced by the end of July.

The plants do not die quickly, as they do when attacked by Fusarium wilt, but may live nearly as long as healthy ones. The growth is checked and the formation of tubers prevented. Often no potatoes are set, or only small ones clustered around the base of the stem, while numerous rudimentary tubers are formed on the stolons.

The browning of the woody part of the potato stem and the presence of a brown discolored ring at the stem end of the tubers is not so much a character of the leaf roll, but is rather to be taken as an indication of the presence of another disease, the Fusarium wilt.

The formation of aerial tubers is sometimes a feature of leaf roll, but in other cases is the result of stem cankers caused by the fungus *Rhizoctonia*.

Leaf roll is considered to be hereditary through the seed potatoes; that is, if potatoes borne on plants affected by leaf roll are planted the resulting crop will be diseased and usually much worse than the first crop.

The cause of leaf roll remains unknown, though it has been prevalent in Europe since 1905, and has been given much study there. It is now believed to be a physiological disorder rather than one caused by a parasite. Many consider it due to some unfavorable soil or climatic condition, but no one has been able to show what conditions produce it or how it may be controlled by any cultural practices.

No fully satisfactory remedy for leaf roll has been discovered. We have, however, the benefit of seven years of German experience with the same trouble. The anxiety caused by its appearance in Germany has been somewhat allayed with the passage of time, and the best authority on potato diseases there even states that through the awakening of interest in better culture and in improvement of seed the leaf roll will prove in the end a benefit to German agriculturists, and their potato production will be permanently increased.

Leaf Scorch. See *Tip Burn*, this section.

Lime-Sulphur Dwarfs Potato Plants
Bordeaux Best for Potatoes

Lime-sulphur solution cannot replace Bordeaux mixture as a preventive of potato diseases. Orchardists who also grow potatoes hoped that they might use the lime-sulphur spray in the field as well as in the orchard and dispense with the Bordeaux altogether, as it would be convenient to prepare only one fungicide; but a careful test made at the Geneva (New York) Station in 1911 proves the lime-sulphur harmful to potatoes. The plants in rows sprayed with lime-sulphur were dwarfed by the fungicide, died early and yielded about 40 bushels less to the acre than plants in check rows; while the Bordeaux-sprayed rows produced 100 bushels to the acre more than the checks.

Geneva (N. Y.) Bulletin 347.

Little Potato. See *Rhizoctonia*, this section.

Potato Scab

Oospora scabies

F. D. Bailey

Potato scab is a fungous disease that is prevalent in Europe and the United States and probably in all countries where potatoes are raised. The chief loss is in the depreciation in value due to the appearance of affected potatoes, although it is claimed that the yield is also reduced.

In the Northwest scab is prevalent only in fields that have been heavily manured, where wood ashes have been applied, or in alkaline soils. An abundance of moisture also favors its spread and development.

Symptoms

This disease is confined to the tubers and is readily recognized by the characteristic rough corky patches on the surface (Fig. 1). The affected spots may be quite deep, even forming cracks if the attack is made when the potatoes are small. The lenticles or openings in the surface are the points more often affected. The first indication is a small reddish-brown surface spot; this grows both outward and downward and soon a brown corky growth begins to form over

Fig. 1. Tuber Affected With Scab.

the diseased area. These spots are rarely more than one-half of an inch in diameter, although many such spots may grow together, forming large scabby areas over the surface.

Cause

The fungus causing this disease is a very minute form. Spores are formed that are but little larger than some of the bacteria. It is a parasite, but is able to live in the soil, in old stems or decaying vegetation for several years. Turnips, beets and mangels are sometimes affected.

Control

Avoid planting on alkaline or heavily manured soils. Where the soil already contains the fungus, practice rotation with crops not affected and where possible plow under green crops.

Avoid planting scabby seed on land that is clean. If it is necessary to use potatoes that are scabby, the following seed treatment should be given:

1. Use a solution of one pint or pound of formalin in 30 gallons of water, soak the potatoes in this for two hours, then spread them out to dry before cutting. The sacks or crates should also be treated at the same time.

2. When a large quantity of seed is to be treated the gas method will be more simple. This method consists in producing formalin gas by adding commercial formalin to potassium permanganate crystals. An air-tight shed should be provided large enough to hold whatever quantity it is desired to treat and providing for an open space near the center, which should be about six feet across. The potatoes to be treated should be dry. They may be kept in sacks or crates and should be stacked in such a way that air spaces are kept open around them. For the gas generator use a large pan or tub, place this in the center of the open space and spread the crystals of permanganate over the bottom. When all is ready add the formalin and leave quickly to avoid the suffocating fumes. Use these substances in the proportion of 23 ounces potassium permanganate with three pints of formaldehyde to every 1,000 cubic feet. Keep the shed closed as tightly as possible for 24 hours. At the end of this time it may be opened and the potatoes taken out.

Since the gas is more effective in a humid atmosphere, it is a good plan to sprinkle the floor with water before starting the sterilization.

Potato Wart, Potato Canker

Synchitrium endobioticum Perc.

This is one of the most important European diseases. It is caused by a fungus, and is extremely difficult to control. It has been introduced into Newfoundland. On the severely affected tubers it causes coral-like scaly nodules, which are readily recognized. Seed potatoes may be slightly affected and escape notice. The danger of the introduction of this disease has been greatly reduced by the quarantine which the United States Department of Agriculture has placed on all foreign countries in which it is known to exist.

However, growers should be constantly on the lookout for it.

New Jersey Agricultural Experiment Station Circular 33.

POWDERY DRY ROT. See *Dry Rot*, this section.

Powdery Scab

Spongospora subterranea Wallr.

This serious disease of the potato has recently been introduced into Canada from Europe and has spread to one of the seed-producing sections of Maine. In 1914 there was a quarantine established by the federal authorities against exportations of seed potatoes from that state.

The Government also prohibits importations of potatoes from countries where the disease is known to exist.

Prof. J. W. Morse, of the Maine Experiment Station, describes the disease as follows:

"The early stages of powdery scab on young tubers appear in the form of small pimples, with a slight discoloration of the surface. When cut open the infected areas appear purplish. These minute pustules may occur in patches or scattered over the surface of the tubers. As they enlarge they become raised and break through the epidermis, which stands up and curls back around the spots in a characteristic manner.

"If the surfaces of the diseased potatoes have not been exposed to too much friction specimens may be collected frequently in the storehouses in the winter which show distinct raised, blister-like, dark-colored spots, usually not more than one-sixteenth to one-eighth of an inch in diameter, in no way resembling the common type of scab. These are shown indistinctly on the surface of the apparently decayed tuber.

"If the top of these blisters or pustules is carefully removed by means of a needle or penknife the interior will be found to be filled with dead tissue and a dark-colored or brownish powder, frequently having a slight olive tinge. Usually, however, when affected tubers come under observation they have been subjected to more or less friction, which has not only removed the top of the pustules but most of the powder as well. After one acquires a slight familiarity with the disease one can usually recognize it without trouble, even in this stage, on account of the size, grouping and appearance of the spots.

"Unless several spots have run together and coalesced, they are usually oval to circular in shape, small, seldom more than one-sixteenth to one-eighth of an inch in diameter; frequently several occur together in clumps. Occasionally they may extend diagonally across the surface of the potato in more or less irregular, parallel lines. The ragged, turned-back margins of the rutpured epidermis already mentioned are usually still in evidence after the tops of the pustules have been rubbed off.

"This is by no means the only form of alteration that the parasite may produce in the normal appearance of the host. In severe attacks, especially in moist soil, a distinctly warty appearance may develop, quite different from the ordinary type of powdery scab. These warts are several times larger than the scab pustules and are usually smooth and roundish, although somewhat irregular, varying in color from a light to dark brown and more frequently occurring at the terminal or seed end of the tuber. Still another stage is recognized, where considerable portions of the surface of the tuber become destroyed and eroded, leaving a distinct, hollowed-out, cankerous area.

"A few other characteristics of the disease as observed in Maine should be noted. The most important is, perhaps, that potatoes affected by powdery scab, especially in severe or moderately severe cases, show a tendency to wither rapidly. This takes place even under good storage conditions, and it becomes very evident if the tubers are removed from the cellar and kept at the temperature of the average living room for a few days.

"Very frequently the skin of the potato in a circle immediately surrounding the individual scab spots becomes depressed and browned, taking on a color very sim-

ilar to that produced by the common dry rot associated with the late blight fungus. This similarity to the late blight dry rot is greatly increased if the spots of powdery scab are numerous and close together, so that the discolored area of the skin becomes continuous.

"In such cases the tissues dry out and shrink away very rapidly beneath the discolored area, giving every appearance of a form of dry rot. Cutting through these blackened areas of the surface usually reveals simply a thin layer of dry, dead tissue resting on the apparently sound and healthy flesh of the tuber below. Frequently a distinct stratum of dry rot has been found beneath some of these discolored areas, but whether or not this is due simply to secondary infection by some fungus I am not yet able to say."

Thus far no satisfactory method of seed treatment has been devised. When the soil is once infected it requires several years' rotation of crops to eradicate the organism.

It is unwise to buy seed potatoes from localities where the disease is known to exist; examine the seed carefully before planting; treat the seed with formaldehyde or corrosive sublimate even though neither of these treatments is an absolute preventive.

Rhizoctonia, Little Potato

Corticium vagum var. *solani*

F. D. Bailey

This disease is widely distributed in this country and in Europe and Asia. The fungus causing it attacks many other plants, and consequently is an organism having a wide range of destruction. It is often present when very little damage is caused, however, and seems able to live indefinitely in the soil.

During the season of 1912 this disease has been found on potatoes in the Pacific coast region, and has caused a loss of 30 per cent in some cases.

Symptoms

The affected plant displays a number of symptoms, some of which accompany the disease only under certain conditions.

Fig. 1. Rhizoctonia on the Stem of a Young, Rapidly Growing Potato Plant.

We often find aerial potatoes produced resulting from early attacks of the fungus. This does not always follow, however. Sometimes this production of aerial potatoes is brought about in other ways. It has been observed in a field where gophers had worked around the roots and cut the underground stems of the plants. Many times the tops are large, or an abnormal branching, resulting in a rosette, accompanies the attack on the underground parts; in this case many small potatoes are produced close to the surface of the ground. Sometimes as many as 50 potatoes, varying from the size of a pea to that of a hen's egg have been found in such hills.

When conditions are favorable for the fungus to attack the plant early in its growth, death may follow immediately. In such cases the stem rots off at the surface of the ground and the plant falls over. Fig. 1 shows the grayish white fungous growth on the stem just above the surface of the ground. The stem

has not rotted off, yet the plant was too young and succulent to withstand the attack for any length of time.

Rhizoctonia, as it occurs in this country, probably does not directly damage the tissue of the tubers, but it frequently forms small, irregular growths on the surface which give them a scabby or dirty appearance. These fungous growths are so firmly attached that a vigorous scrubbing is necessary to break them away. When wet they are black in color. (Fig. 2.)

Cause

The fungus causing this disease is closely related to the mushrooms and toadstools. It was, for many years, considered a sterile fungus, and supposed to have no true spore stage. This has been disproved and the classification changed, since it has been found that spores are produced.

The fungus can live indefinitely without the intervention of the spore stage, and it is probable that it depends largely for its distribution and perpetuation on the small patches of fungous tissue (sclerotia) that are formed on the surface of the potatoes and stems. (Fig. 2.)

Control

Since this fungus is able to live in the soil indefinitely, it is necessary to observe special precautions against introducing it. It is introduced, in most cases, on seed. Careful inspection for the presence of the small black bodies on the surface of the potatoes should always be made before planting and, in case they are found, the general seed treatment as recommended for potato scab should be used.

Liming the soil and rotation with crops which are not affected is also recommended where the disease is prevalent.

Formaldehyde and Corrosive Sublimate for Scab and Rhizoctonia in Potatoes

The following discussion is from the New York (Geneva) Station:

It seems best to advise potato growers who wish to disinfect potatoes they use for seed to use the gas treatment only in cases where it is impracticable to use either the liquid formaldehyde solution or corrosive sublimate. The safety and efficiency of both the liquid treatments for scab have been thoroughly established, while the evidence proves the gas treatment unreliable for controlling Rhizoctonia, and casts considerable doubt on its effectiveness against scab. When it is desired to treat potatoes for both Rhizoctonia and scab the corrosive sublimate solution should be used; but in treating for scab alone the formaldehyde solution is effective, while the corrosive sublimate solution, though effective, is in many ways less desirable to use.

Directions for Using Treatments

The method to be used in applying any one of these treatments is summarized in the following paragraphs, which should be carefully read before beginning the work.

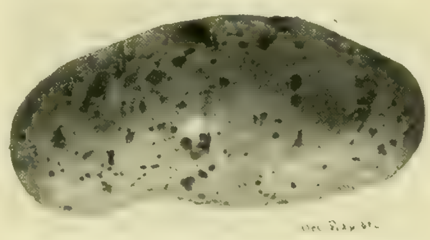


Fig. 2. The small black patches on the surface of the tuber are a resting condition of Rhizoctonia and furnish a means for its distribution.

Formaldehyde Gas

Use a thoroughly tight, unheated room. Place the seed tubers in shallow, slatted crates, not over eight inches deep, and so arranged that the gas may circulate freely on all sides of the potatoes. For each 1,000 cubic feet of space in the disinfection room use three pints of formaldehyde (40 per cent solution) and 23 ounces of potassium permanganate (slender, needle-shaped crystals). Spread the potassium permanganate over the bottom of a large pan or pail having a capacity equal to about one quart for each ounce of permanganate. Pour on the formaldehyde, close the door at once and keep it closed for 24 hours. It is important that the disinfection room contain ap-

proximately 10 pounds of potatoes per cubic foot or 167 bushels per 1,000 cubic feet. With smaller quantities the tubers are liable to be injured by the treatment; while with larger quantities the treatment may not be effective. If necessary to treat smaller quantities than 10 pounds per cubic foot it is suggested that a smaller room be fitted up for a fumigator if possible, or that the quantity of chemicals be reduced proportionately. No tubers should be placed directly above the generator. If possible, the treatment should be made before the tubers have begun to sprout as sprouted tubers are more liable to injury. The temperature of the chemicals at time of mixing should be above 50 degrees Fahrenheit.

Formaldehyde Solution

Mix one pint of 40 per cent formaldehyde solution with 30 gallons of water. Soak the uncut tubers in this solution for two hours. The same solution may be used repeatedly. Treated tubers not required for planting may be used for food or fed to animals with perfect safety.

Corrosive Sublimate Solution

Prepare a solution containing 2 ounces of corrosive sublimate in 15 gallons of water. This is best done by first dissolving the corrosive sublimate in a small quantity of hot water and afterward diluting to the required amount. Soak the uncut tubers in this solution one and one-half hours. Recent investigations by Gussow and Shutt in Canada indicate that the strength of corrosive sublimate solution decreases so rapidly with use that it is necessary to reject it after using three or four times. As the solution corrodes metals it should be used only in wooden or stone vessels. These should be kept away from animals until very thoroughly cleansed from the solution. It is very poisonous. All treated tubers should be either planted or buried.

With any of the scab treatments care should be taken that treated tubers are not reinfected by coming in contact with bags or crates which have held scabby potatoes.

New York (Geneva) Bulletins 369 and 370.

ROSSETTE. See *Rhizoctonia*, this section.

Russet Scab

A russet scab has been reported as more or less common in a number of states, and has been attributed to the Rhizoctonia fungus, but the cause is not well understood.

Silver Scurf

This is a new fungus disease, *Spondylocladium atrovirens* Harz, introduced from Europe. The disease appears as small dark spots on the skin. In storage, these spots enlarge and the tuber shrivels and becomes somewhat silvery in appearance.

Control

It is very doubtful if this disease can be controlled by seed disinfection, hence seed selection is the only alternative.

Soft Rots

Various Causes

Several soft or wet rots commonly affect tubers in the field or after storage. They seem to be caused in each case by bacteria, and are not to be confused with the *Fusarium* or *Phytophthora* dry rot, although they often follow these as well as scab injury. Dig the potatoes as soon as possible if wet weather prevails and they have been grown in heavy soil. Store in a dry, cool, well-ventilated place. Rotate crops and avoid using seed potatoes from affected hills. If possible, use hardy strains.

SOUTHERN BACTERIAL WILT. See *Black-Leg*, this section.

STEM BLIGHT. See *Rhizoctonia*, this section.

STEM ROT. See *Rhizoctonia*, this section.

Sun Scald

Symptoms

Wilting and burning of the tender young leaves in June and early July during very bright, hot weather; especially likely to occur after a period of warm cloudy weather. The youngest upper shoots suffer first and worst.

Remedy

There is no remedy, and since the plants usually recover quickly, little permanent injury results.

Tip Burn

Symptoms

During protracted dry hot weather in midsummer, the leaves weaken and die, beginning at their tips and margins. The older leaves and those on the lower part of the plants suffer first and worst. This has been a common trouble in Wisconsin potato fields, especially on the earlier potatoes. Anything that weakens the plants or injures the foliage increases this trouble.

Remedies

Soil rich in humus, good surface cultivation to keep down weeds and check evaporation, spraying with Bordeaux mixture to keep the foliage healthy.

L. R. Jones,
Madison, Wis.

Verticillium Wilt

Verticillium alboatrum Reink. and Berth.

This is due to a fungus and is very similar to the Fusarium wilt. The black discoloration of the tuber is much more pronounced than in the case of the Fusarium wilt and the wilting is more rapid. It is not so common nor so widely distributed.

New York Agricultural Experiment Station Circular 33.

Wilt. See *Dry Rot*, this section.

POTATO PESTS

Beet Army Worm. See *Beet Pests*.

Colorado Potato Beetle

Leptinotarsa decemlineata Say

A. L. Lovett

This insect is fortunately so far not known to be present on the Pacific coast, except in a small area in Eastern Washington and Northern Idaho. That this condition of freedom can long exist seems rather doubtful. There is practically no one interested in potato culture but who knows the vivid examples we have had in the Middle West of what this pest is capable of doing.

Description

The adult beetle is of a very robust form. About three-eighths of an inch in length and a little more than half as wide. It is of a dusky yellow color, the wing covers marked with ten longitudinal black stripes. The larvae resemble slugs, but have only three pairs of legs located on the three segments just back of the head. They are of a dark venetian red, soft in texture and are slimy disgusting looking creatures. The pupal stage is passed in the soil. The pupa is about the color of the larva but shows the forming legs, wings, etc. The eggs are a lemon yellow and are laid in masses on the leaf, usually on the under side near the mid-rib. They are also deposited on straws, dried roots, etc., which protrude above the ground.

Both the adult beetles and the larvae feed voraciously on the foliage of the potato. The beetle is a fairly strong flier and on warm sunshiny days often takes wing and flies about. The insect passes the winter as an adult beetle, usually hibernating in the soil or in a very well protected spot. They emerge in very early spring and feed on any of the Solanaceae that are handy. They deposit eggs on their host, but this egg-laying extends over a considerable period of time, the beetles depositing more eggs whenever they migrate to a new host. There are ordinarily two broods during each season.

Remedies

Where this insect is very bad no remedy will prove entirely efficient, but the arsenical sprays are the standard solution for their control.

Common Nematode. See *Potato Eelworm*, this section.

False Chinch Bug. See *Cabbage Pests*.

Flea Beetle. See *Western Flea Beetle*.

Grasshoppers. See *Grape Pests*.

Green Peach Aphids. See *Aphids*.

Harlequin Cabbage Bug. See *Cabbage Pests*.

Hop Flea Beetle. See *Cabbage Pests*.

Jerusalem Cricket. See *Sand Cricket*, this section.

Mealy Bugs

Tuber Mealy Bug

Pseudococcus affinis Mask.

The tuber mealy bug occurs in Australia, and is found upon the tubers of dahlias and potatoes.

Solanum Mealy Bug

Pseudococcus solani Ckll.

Color

The body is pale yellowish and sparsely covered with fine white powdery wax.

Food Plants

This species appears to be a subterranean form and lives either entirely under ground or upon the branches which touch the ground. It has been found feeding upon the following plants: *Aster*, sp. nightshade, pigweed, potato, purslane, wild sunflower, tomato.

E. O. Essig

Potato Eel Worm or Common Nematode

Heterodera radicicola Greef.

General Appearance

The presence of this pest is told by such characteristic injuries as root knot on nursery trees, galls on tomato vines and the rough warty surface of potato tubers. The animal causing the injuries is commonly known as the nematode worm and was recently given much prominence as the potato eel worm. The males and young, the usual forms of the animal, are microscopic, transparent and shaped much like minute eels. The female is pear-shaped and pearly-white. The eggs are oval in shape and laid in great numbers.

Life History

The young eel worms feed upon the roots of various plants causing galls or knots which may greatly impair growth. The female develops within the affected areas and begins egg-laying, the young hatching in a very short time afterwards. The winter is passed in the original host if it remain growing in the soil, such as nursery stock, but if the host is removed they feed upon various plants left in the fields. The young have the ability to encyst themselves so as to resist great extremes of weather and unfavorable conditions, so once in the soil it is very dificult to eradicate them.

Food Plants

According to Dr. E. A. Bessey there are 480 species and subspecies of plants afected by root knot. The list includes members of practically every flowering plant. Most of the garden plants are affected, as are many of the field crops and fruit trees. For definite information concerning the host plants the reader is referred to pp. 10-22, Bulletin 217, Bureau of Plant Industry, U. S. Department of Agriculture, by Dr. Bessey.

Control

The control of this pest is extremely difficult and eradication almost impossible. In greenhouses the soil may be sterilized with steam or formaldehyde (one part to 100 parts of water). Rotation of crops which are not attacked by the nematode is perhaps the best control measure in the field. Summer fallow, frequently turning up the soil and allowing it to dry out, will help to reduce the numbers. Irrigated districts are more liable to become infested, and are very favorable to spread and difficult of control.

E. O. Essig

Fig. 1. Potatoes Showing the Work of the Common Nematode or Eel Worm, *Heterodera radicicola* Greef.

—*Photo by Bremmer*

Potato Tuber Moth

Phthorimaea operculella Zeller

(Family *Gelechiidae*)

General Appearance

The larvae vary from white to slightly pink—the head being black. When full

Fig. 1. Potato Tuber Moth (*Phthorimaea operculella* Zeller). 1, cocoons containing chrysalids; 2, larvae; 3, bare chrysalids. (Enlarged.) —*Essig*

grown they are about one inch long. The cocoon is spun of fine white web, the chrysalis being light brown in color and about three-eighths of an inch in length. The wings of the adults are decidedly gray in color with the bodies silvery. They are about one inch long.

Life History

The small pearly-white eggs are laid on the stems of growing potato plants or upon exposed tubers in early summer, or upon the tubers at digging time. Within 15 days they hatch into caterpillars, which feed upon the leaves, stems or tubers, or only upon the latter when they are stored in bins. It requires from three to five weeks to mature, when it seeks a shaltered place and spins a cocoon, in which to pupate. During the winter the pupal period may occupy several months, but in the summer and fall from 14 to 20 days are required. The adults are night

Fig. 2. Adults of the Potato Tuber Moth (*Phthorimaea operculella* Zeller) enlarged several times. (Essig, M. B. Cal. Hort. Com.)

flyers and are especially abundant in the fall, particularly when early potatoes are dug. If the tubers are exposed over night the females lose no opportunity to deposit their many eggs, generally over all of them, so as to make a serious infestation. The adults live but a few days.

Distribution

Throughout the central and southern parts of California, in Florida, North and South Carolina and Virginia.

Food Plants

Potatoes, tobacco, nightshade, and cat-tails are attacked.

Control

All host plants should be kept from growing in or around the potato fields. Deep planting and hilling should be practiced to prevent access to the tubers. The potatoes should be dug as early as possible and not allowed to remain in the fields over night, unless sacked. In places of general infestations the tubers may be thoroughly disinfected before storing, by soaking them in water for 36 hours. In the storage bins, two pounds of carbon bisulfid to every 1,000 cubic feet of air space will prevent injury, provided this is done four or five times, or as often as adult moths appear.

E. O. Essig

Sand or Jerusalem Cricket

Stenopelmatus irregularis Scudd.

General Appearance

The adults never have wings and are

Fig. 2. (1) Work of Tuber Moth on Potato. (2) Cross-section of Potato Showing the Interior Work of the Potato Tuber Moth. (Essig, M. B. Cal. Hort. Com.)

of a light brown or amber color, with the abdomen dark excepting an extreme posterior band around each segment, which is amber and gives a decided striped appearance. The antennae are long and filiform; legs large and strong. There are two noticeable horn-like processes on each side of the posterior end, which stand perfectly upright. They are light in color and slightly hairy. The ends of all spines are black. The length of the adults varies considerably, but the largest are one and three-quarters inches long. This species is separated from others by having five inner spines above on the hind tibiae, the third and fourth of which have the greatest interspace between them.

They are often responsible for considerable damage to potatoes before they are dug. The tubers are gnawed so as to be unfit for keeping or selling. Occasionally a large proportion of the crop may thus be injured, but this is more likely to happen only in small places.

Control

The most injury is done in fields placed under cultivation for the first time or lands left for some time to sod or pasture. Well cultivated fields seldom if ever suffer from the attacks of this pest. Clean cultivation around the fences so as

to break up the breeding places will practically eliminate all possibilities of injury.

Solanum Root Louse

Trifidaphis radicicola Essig

General Appearance

The apterous females are distinctly globular in shape, and vary from amber to cream-color and often with a fine, white, powdery covering. The winged forms are amber with head and thorax dark. The wings are also dusky. Length, 1 to 2 millimeters.

Life History

The lice are subterranean in their habits and are evident during the early spring and the entire summer. The winged forms appear in July and August. It has not been determined whether eggs are deposited or not, but so far the the writer has been unable to find any.

E. O. Essig

TOMATO SPHINX. See *Tomato Pests*.

TWELVE-SPOTTED CUCUMBER BEETLE. See *Cucumber Pests*.

WESTERN ARMY WORM. See *Beet Pests*.

Western Potato Flea Beetle

Epitrix subscrinita Lec.

A. L. LOVETT.

This potato flea beetle (see Fig. 1) is one of our very serious insects pests of the potato in the Northwest. The trouble it causes and the total injury it does are hard to estimate. The small black-brown beetles, which jump quickly like a flea when approached, are fairly well known. They eat small irregular holes in the foliage of the potato, tomato and other crops. From these feeding punctures a fungus spreads. The total leaf surface thus destroyed is considerable, and where the attack is severe the food supply of the developing tubers is materially cut down. The larvae are small, white and thread-like. They occur below ground, feeding on the underground stems of the potato plant and also on the tubers. They give the potatoes a peculiar pimply appearance, which may affect their commercial value. There are two generations in a season. The beetles from the fall generation pass the winter as adults, and attack the crops in the spring. The summer generation, which really does the most injury, appears about July 10 to August 5.

Remedies

Spray with Bordeaux mixture.

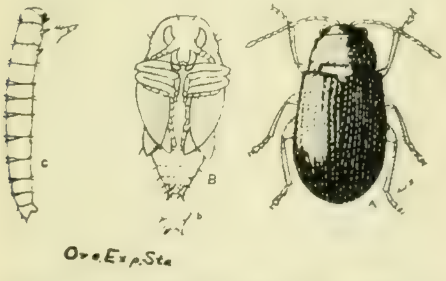


Fig. 1. The Western Potato Flea Beetle. A. adult beetle; B. pupa; C. larva. (Original.)

Fig. 2. The Western Potato Flea Beetle. Potato foliage showing injury. (Original.)

White Grubs

Lacnosterna sp.

For description and control see *Strawberry Pests*.

NOTE.—Other species of flea beetle attack tomato in other parts of the country. Same remedy applies.—Ed.

White Grubs and Potato Injury.

Wire Worms

Elateridae

A. L. Lovett

Fields are sometimes found infested with elongated, worm-like larvae with a hard, smooth, reddish brown surface. The segments are very well defined, and on the first three, just back of the head, are a pair of short, stout legs. The head is flattened, wedge-shaped and fitted with a pair of powerful jaws, which enables the insect to bite roots and tubers with great ease. These wire worms vary from one-half inch to an inch and a quarter in length, are active, strong and hard to hold.

Fig. 1. Adult Wire Worms.

Fig. 2. Wire Worms.

Remedies

A well-planned rotation of crops, with the object of getting as far as possible from the grass family, is recommended.

Traps, consisting of boards or stones placed about the field with poison dainties beneath them, such as bran mash or some sprayed succulent crop, are good.

Salt, at the rate of from 250 to 500 pounds to the acre, or even in greater amounts, is recommended by some of the successful onion growers as an effective remedy for wire worms. No careful experiments have so far been undertaken by this station, however, and we cannot commit ourselves as to the value of this treatment.

PRAIRIE APPLE. See *Apple, Botany of.*

Pre-cooling of Fruits

Pre-cooling is a term that is used to designate the process of cooling fruits before shipping. Every year adds to the importance of this process.

Mr. A. V. Stubenrauch, expert of the Department of Agriculture in charge of storage investigations, says that pre-cooling has become a very important factor in the transportation of fruit. To the grower and shipper it is important as a means of extending the marketing area of the product by assuring its delivery in sound condition over long distances. To the carrier the sound condition of the fruit is an important consideration, but mainly from the traffic standpoint. Pre-cooled fruit may be loaded more closely and heavily, thereby increasing the carrying capacity of the cars, and less ice will be consumed en route. But whether the reduction of the initial temperature is properly the function of the shipper or the carrier is still an open question.

As an adjunct to careful handling in preparing fruits for market, pre-cooling will materially assist in minimizing losses from decay and deterioration in transit. It is in no sense a panacea for all the difficulties of carrying fruits in sound condition to distant markets. It cannot improve the quality or condition of the product packed, and can only temporarily retard decay following injuries made by rough handling, but it renders unnecessary the packing of such fruit as peaches, plums, and apricots in a hard, green condition in order to offset the ripening which takes place in cars under ordinary icing methods. It reduces the differences frequently occurring between the top and bottom tiers of the load by equalizing temperature conditions within the car.

Results of Pre-cooling Experiments on Bartlett Pears in the Rogue River Valley, Oregon—Season of 1912.

Two facts make this experiment of great value to the pear growers of the Rogue River valley. The first is the extensive plantings which have been made there. Fifty thousand acres represented the area planted to pears in 1912, and plantings were still being made. The second is the fact that Rogue River pears marketed during the first half of the season do not bring such high prices as those marketed later, on account of competition with California pears.

These facts make it important that the Rogue River pear season be extended materially; and the Bureau of Plant Industry authorized an investigation of the problem.

The experiment covered 384 boxes of Bartletts, taken from three different types of soil. Four pickings were made, one week apart, three weeks elapsing between the date of the first and last pickings. Half of each picking was pre-cooled, while the other half was handled under average commercial conditions.

Results of the Experiments

While it is realized that the work here reported must be considered as only preliminary, indicating the scope which future investigations should follow, the results were striking and consistent throughout, and sufficient data are at hand to warrant a full commercial test and demonstration of this method of marketing. Bartlett pears in the Pacific Northwest. Further study is necessary in order to determine the factors of seasonal

influence, which must be taken into consideration before all phases of the problem are solved.

The results indicate that the marketing season of Bartlett pears can be lengthened or extended six or seven weeks, provided some changes are made in the method of handling the crop.

The pickings as a rule should be made fully two weeks later than is the ordinary practice. At this time the fruit will be of larger size, of better quality, and in every way will hold up better in storage and in transit. There will be some dropping where the fruit is held on the trees two weeks longer, but this will largely be offset by the increase in size and the improvement in keeping quality. It is also of the greatest importance that the fruit be placed in storage or in an iced refrigerator car as soon as possible after picking, as a delay in cooling of even two days caused much more deterioration than occurred in fruit stored immediately, whether packed before or after cooling.

The results also indicate that the practice of picking the trees clean at one picking, especially early in the season, is not conducive to the best keeping quality and uniformity. Where only one picking is made, and that early, much of the fruit is picked while it is still immature, and this fruit will show a great deal of wilting, shriveling, brown stain or scald, and physiological decay, thereby detracting from the appearance of the pack and lessening the returns from the fruit which was of proper maturity when picked. The pickings can be extended over a longer time than is generally believed to be the case, and this is especially true where two, or possibly three, pickings are made during the season.

The results further indicate that when picked at the proper time and when carefully handled and promptly pre-cooled, Bartlett pears stored for four weeks at the shipping point and afterwards loaded into pre-iced refrigerator cars and shipped to Eastern markets will arrive in sound, marketable condition and remain sound for a sufficient time to allow reshipment and consequent wide distribution to ultimate consumers. The season can be extended from six to seven weeks by leaving the fruit on the trees two weeks longer than is at present the practice, and by storing for four or five weeks at a temperature of 32 degrees or 34 degrees Fahrenheit after the fruit has been pre-cooled.

Bureau Plant Industry Circular 114.

Pre-cooling Investigations

A. V. STUBENRAUCH

*It is wholly impossible to discuss the question of the pre-cooling of fruit without reference to the importance of the handling given the fruit in preparing it for shipment or storage, and it will be necessary to devote a large part of the discussion to handling problems.

The term "pre-cooling" has been applied to the method of promptly and rapidly reducing the initial temperatures of produce intended for shipment. The work requires special equipment aside from that needed to maintain the low temperature after the initial heat has been removed.

Pre-cooling, or chilling, has been used for a number of years in preparing meats for shipment, or storage, but as far as is known, the first application of this process to the handling and shipment of fruits was made in 1904 by Mr. G. Harold Powell, who was then in charge of the fruit transportation and storage investigations of the Bureau of Plant Industry. The first work consisted of the pre-cooling of peaches intended for shipment from Georgia to northern markets. The equipment used was necessarily rather crude; yet some very definite results were obtained. Later on, the process was applied to oranges and deciduous fruits in California; and since Mr. Powell's early work, special attention has been given by the office of Field Investigations in Pomology to the investigation of the problems connected with the pre-cooling of different fruits. In addition to oranges and peaches, these investigations have been extended to table grapes in Califor-

* Washington State Horticultural Association 1912 Report.

nia, and last season work was begun on cherries and fresh prunes in Oregon, and raspberries in Washington. Special equipment has been supplied in order to enable the work to be carried on at different points in the United States.

In an article on "The Pre-cooling of Fruit" in the Year Book of the Department of Agriculture for 1910, a general discussion of the subject was presented, and the following paragraphs are quoted from that article:

"*The Reasons for Pre-cooling.* During the maturing of a normal fruit on the tree certain chemical and physiological changes are constantly taking place within the fruit itself. These changes, which result in the acquirement of quality and flavor, constitute the ripening process. After a certain point is reached the fruit becomes overripe, quality and flavor are lost, and deterioration progresses until eventually the fruit is destroyed by fungous decay or fermentation or through destructive physiological changes.

"A fruit may be considered as a living organism which has a definite span of existence, the length of this span depending upon the conditions surrounding the organism. The most important factor which modifies this span of life is temperature. When the fruit is removed from the parent plant the life processes constituting ripening are materially hastened, and the life span is greatly shortened if the fruit is allowed to remain warm for any considerable length of time. Hence, the importance of reducing the temperature as promptly and rapidly as possible after the fruit is picked.

"The length of the life span differs with the character of the fruit. It is shortest in the soft fruits, such as berries, cherries, peaches, apricots, plums and most pears, and longest for the harder fruits—citrus fruits and apples. It varies with different varieties within the same group of fruits. Some varieties of apples, for example, keep longer than others; lemons keep longer than oranges. The importance of quick and prompt cooling—precooling—then, is greatest in the case of the soft fruits and least for the harder fruits. Experience so far confirms this rule.

"Aside from the breaking down from overripeness, fruits are subject to premature decay due to the attacks of various fungi. The most common forms of these fungi, however, have not the power to penetrate the sound, unbroken skin of a healthy, normal fruit. Most of the decay occurring in fruits in transit and storage starts at injuries and breaks in the skin, caused almost entirely by rough handling in preparing the fruit for market, either in picking, grading, hauling or packing. Wounds, bruises, scratches or abrasions of any kind allow the organism of decay to gain entrance. Other fungi which are not dependent upon injuries to start, attack fruits in transit and storage; but these forms of decay are much less prevalent.

"The germination of the decay spores, which are analogous to the seeds of higher plants, is dependent upon proper moisture and temperature conditions. Germination does not take place while the fruit is perfectly dry or when the temperature is low. After the spores have germinated, however, and the decay has started within the fruit, even as low a temperature as 32 degrees Fahrenheit will not wholly check it. Growth of the mold is only retarded and the decay continues slowly to develop."

The prompt and rapid reduction of the temperature below the point where decay spores germinate prevents the development of the disease. Some fruits which have been rendered susceptible through mechanical injuries occurring in handling may be transported with only slight loss from decay when promptly cooled. It is not safe, however, to depend upon precooling to prevent decay which follows improper handling. Pre-cooling should never be expected to replace proper work. The fact that it does not always effectively replace careful handling is shown by the Bureau investigations with table grapes.

It has been the policy of the Bureau to advise conservative caution in the appli-

cation of pre-cooling on a commercial scale. It was realized that pre-cooling would not prove a panacea for all of the troubles which the different fruit industries were experiencing in transporting fruits to market. The importance of careful handling was consistently urged and all efforts were made to emphasize the necessity of handling the various fruits in a manner to insure their sound carrying qualities. The Bureau work has shown that there is a consistent relation between the type of handling given fruits in preparing them for shipment and their behavior during transit and storage. There is practically no way to avoid responsibility for the occurrence of decay and deterioration due to careless handling on the part of the grower or shipper who prepares the fruit for market. To use pre-cooling as a means to overcome difficulties which ordinarily can be eliminated by packing the fruit in sound condition, is not only poor policy, but is dangerous to the reputation of the product. Pre-cooling does not absolutely prevent decay. The reduction of the temperature simply arrests the development of mold and therefore the deterioration due to these agencies occurs after the fruit arrives in market. Such fruit will soon gain a reputation of poor shipping qualities. The correctness of this early conclusion regarding the uses of pre-cooling have been emphasized by later work with table grapes. With this class of fruits, the results of three consecutive seasons show that pre-cooling does not effectively replace careful methods of handling. There was in some instances a slight reduction in decay due to injuries or to other causes in cars which contained pre-cooled fruit, but the benefits from the pre-cooling process without attention to careful handling were not sufficient to justify the extra trouble and expense.

In order to emphasize the results from the table grape handling and pre-cooling work, the accompanying tables and charts, giving summaries of the three seasons' work on Tokay grapes from California are presented:

Table I. Average Percentages of Decay in Shipments of Tokay Grapes from Lodi, California, to New York City, Seasons of 1908, 1909, 1910.

	On Arrival.	2 Days After Arrival.	4 Days After Arrival.
Season of 1908—			
Packed in ground cork	1.6	4.2	6.6
Carefully handled in crates	4.2	7.8	16.2
Commercially handled in crates	9.6	14.7	33.9
Season of 1909—			
Packed in redwood sawdust	0.2	0.6	0.7
Carefully handled in crates	0.9	2.6	5.1
Commercially handled in crates	4.4	7.4	15.8
Season of 1910—			
Packed in redwood sawdust	2.2	3.6	4.2
Carefully handled in crates	4.0	5.8	9.3
Commercially handled in crates	6.5	9.6	15.8

A glance at the figures shows that by careful handling, aside from pre-cooling, the decay in grapes shipped from California may be held at a minimum. The figures presented comprise the results obtained from the systematic handling, shipping and inspection of a large number of crates of grapes produced under a wide range of conditions. The figures also show the behavior of this fruit after arrival in market. Inspections were made on the day of arrival, after holding two days and after four days; the fruit being held under open market conditions and without refrigeration. The consistent effect of careful handling after the fruit arrives in market is strikingly shown. The importance of having such perishable fruit hold up after it arrives in market need hardly be emphasized. Grapes which arrive with as low a percentage of decay as is shown in the figures for the carefully handled lots on arrival in New York may be reshipped to neighboring cities with perfect safety; whereas, the commercially handled lots deteriorate so

rapidly after arrival that they must be immediately consumed, otherwise a large proportion of the fruit is wasted. The figures also show the percentages of decay obtained from grapes packed in ground cork and redwood sawdust. The use of a filling material in packing California table grapes reduces the decay percentage to a minimum. It has not been thought wise to advise the change from the old method of packing in crates to one using a filler because of the difficulty of introducing a new style of package under commercial conditions. From the last season's experience, however, there is some indication that at least the best grades of grapes may be packed with this filler, and an attempt will be made to introduce this new system of packing for ordinary commercial shipment next season.

Table II. Average Percentages of Decay in Pre-cooled and Non-Pre-cooled Commercial Shipments of Tokay Grapes from Lodi, California, to New York City, Seasons of 1909, 1910 and 1911.

	On Arrival.	2 Days After Arrival.	4 Days After Arrival.
Season of 1809—			
Pre-cooled	6.6	12.7	16.8
Non-pre-cooled	7.5	10.9	15.1
Season of 1910—			
Pre-cooled	7.4	11.1	15.1
Non-pre-cooled	8.7	12.2	17.5
Season of 1911—			
Pre-cooled	6.5	12.2	16.7
Non-pre-cooled	8.1	12.8	17.6

Table II shows the results from comparable shipments of pre-cooled and non-pre-cooling table grapes to New York during three consecutive seasons. No attempt was made to handle these grapes carefully; the ordinary commercial pack was used. The pre-cooling was accomplished by means of a cold-air blast circulated through the cars until the average temperature of the fruit was reduced to a point near 40 degrees. The figures show that decay was slightly less in the pre-cooled cars, but the differences are not sufficient to warrant any considerable extra expense. A greater reduction in decay was accomplished by careful handling without pre-cooling than by pre-cooling alone.

This is a most important point, and one which cannot be too strongly emphasized. The tendency to regard pre-cooling as a means to overcome all of the difficulties which are experienced in transporting fruits is widespread, and while we feel that this system of preparing fruits for shipment over long distances is a most important one, and one which will have a very great influence on the carrying qualities of fruit after the grower, the packer and the shipper have done their share to insure the preparation of the fruit for market in sound condition, pre-cooling must not be depended upon to replace all of these special efforts.

The fruit-handling investigations of the Bureau of Plant Industry have been in progress about ten years. During that time a very comprehensive study has been made of the relationship of handling various kinds of fruit to their behavior in transit, in storage and while on the market. This study has been extended to the California orange and lemon, the California table grape, the Georgia peach, the Florida orange and pomelo, and last season investigations were begun with red raspberries in Washington, and cherries and fresh prunes in Oregon. The results of these studies covering a wide range of fruits are consistent throughout and show a very definite relation between the methods of handling the fruits and their behavior after packing. I will not attempt to give all of the data which have been accumulated along these various lines. It is, however, important to present some of the results in order to show how conclusive and how consistent the work has been.

Table III. Florida Orange Shipping Experiments, Season of 1910-1911. Average Per Cent Decay in Eighteen Experiments in Seventeen Packing Houses.

	On Arrival.	At End of 1st Week	At End of 2d Week.	At End of 3d Week.
Careful pick and pack	0.7	1.4	1.7	2.0
Commercial pick, careful pack	2.9	5.3	7.0	7.9
Commercial pick and pack	6.7	12.1	15.3	16.6

In Table III the results from the shipping experiments with Florida oranges during the season of 1910-11 are shown.

The fruit used in these experiments was obtained from 17 packing houses located in various parts of the Florida citrus districts. The fruit used therefore was produced under a wide range of conditions, and the investigation was continued throughout the entire shipping season. The data are therefore the result of a large number of experiments consisting of a sufficient number of boxes of fruit to place the work on a commercial basis. A glance at the figures shows the consistency of the general principle expressed above. Of all of the series of oranges picked, packed and shipped by the Bureau workers, the percentage of decay was only .7 per cent on arrival at Washington, D. C. The fruit was held for three weeks, inspections being made at the end of the first, second and third weeks. At the end of the first week the carefully picked and packed fruit showed 1.4 per cent, while at the end of the second and third weeks, respectively, 1.7 and 2 per cent decay developed. Contrast these figures with the fruit picked and packed under ordinary commercial conditions. On arrival the commercially picked and packed fruit had 6.7 per cent decay, and after holding one week 12.1 per cent, after two weeks 15.3 per cent and after three weeks 16.6 per cent.

Red Raspberry Handling and Pre-cooling Experiments

This work was begun during the season of 1911, and records from only one season are available. All pre-cooling was done after the fruit was loaded into the cars. The data obtained were clear cut and are consistent with the general principles developed with other fruits; they are presented as additional corroborative evidence.

Table IV. Red Raspberry Handling Experiments, Puyallup, Washington, Season of 1911.

	Carefully Handled.		Commercially Handled	
	On Withdrawal. % Decay	One Day After. % Decay.	On Withdrawal. % Decay.	One Day After. % Decay
Four days in refrigerator car	0.2	0.6	1.4	12.2
Six days in refrigerator car	0.3	3.5	7.2	27.6
Eight days in refrigerator car	1.7	7.8	22.2	44.3

Table V. Red Raspberry Pre-cooling Experiments, Puyallup, Washington, Season of 1911.

	Pre-cooled. Commercially Handled.		Non-Pre-cooled. Commercially Handled.	
	On Withdrawal. % Decay	One Day After. % Decay.	On Withdrawal. % Decay.	One Day After. % Decay.
Four days in refrigerator car	2.1	9.5	5.9	16.5
Six days in refrigerator car	9.1	19.1	15.4	28.8
Eight days in refrigerator car	18.4	35.2	27.4	45.8

It was impracticable to obtain the inspection data after shipment to Eastern points. The raspberry crates were therefore held in an iced refrigerator car at Puyallup, Washington, and the lots of fruit were withdrawn after holding periods, which represent trips of four, six and eight days respectively. The conditions for rapid cooling in the iced car at Puyallup were considerably more fa-

vorable than obtain during a transcontinental trip. The car was kept fully iced throughout the season, and at no time was a full carload of fruit on hand. The fruit held without pre-cooling was therefore cooled much more rapidly than would have been the case under actual shipping conditions. It is necessary to take these factors into consideration in making comparisons of pre-cooled and non-pre-cooled crates. It is only fair to assume that under shipping conditions the decay in non-pre-cooled berries would be higher than shown by these experiments. The point to be drawn from these figures is the consistently clear-cut results from careful handling with this very perishable fruit. The two tables should be considered separately and are not comparable. Only the data obtained from actual comparable series of experiments are included in the figures shown in each table, and the series for the handling and pre-cooling experiments are not the same. The figures for the percentages of decay in the pre-cooled lots do not tell the whole story. The pre-cooled berries presented a much brighter and more favorable appearance than the non-pre-cooled, and the consensus of opinion of all who examined the fruit was that a material benefit resulted from the pre-cooling. This need not in any way detract from the importance of the results from the handling experiments.

Cherry and Fresh Prune Handling Experiments

This work was begun at Salem, Oregon, during the season of 1911. The results are given in order further to emphasize the consistency of the careful handling principle.

As in the case of the raspberry experiments, it was impracticable to make inspections after actual shipment and the lots were held in an iced car for periods representing trips of 10, 15 and 20 days respectively. The conditions were only approximately those of a car in transit, as owing to the car being only partially filled, the temperature conditions in the car were more favorable than during shipment with a full carload. The fruit was held after withdrawal from the car under open market conditions.

Careful handling in the work with cherries and prunes consisted not only in using care in picking and packing, but in grading or culling out all imperfect fruits. The season was very unfavorable, there having been considerable rain during the shipping season, and a large proportion of the fruit was cracked and otherwise damaged. These were carefully culled out as far as practicable in the carefully handled lots; in the commercial packs, little attention was paid to culling out the imperfect fruits.

Table VI. Average Percentages of Decay in Carefully Handled and Commercially Handled Cherries at Salem, Oregon, 1911.

	Carefully Handled		Commercially Handled.	
	At Withdrawal. % Decay	Two Days After. % Decay.	At Withdrawal. % Decay.	Two Days After. % Decay.
Five days in refrigerator car	0.5	3.5	2.8	10.8
Ten days in refrigerator car	1.5	3.5	12.3	21.4
Fifteen days in refrigerator car	4.3	7.3	16.0	26.1

Table VII. Average Percentages of Decay in Carefully Handled and Commercially Handled Fresh Prunes, Salem, Oregon, 1911.

	On Withdrawal. % Decay	Two Days After. % Decay.	Four Days After. % Decay.	Six Days After. % Decay.
Ten days in refrigerator car—				
Carefully handled	0.7	1.2	1.6	2.1
Commercially handled	3.5	5.6	9.3	8.7
Fifteen days in refrigerator car—				
Carefully handled	0.4	1.2	2.1	3.7
Commercially handled	7.1	8.8	11.5	16.6
Twenty days in refrigerator car—				
Carefully handled	2.7	3.8	4.7	6.9
Commercially handled	6.8	9.7	19.3	23.3

Preserving Fruits for Exhibition

Fruits for preservation and show purposes should be put up when very firm, and for at least 48 hours after being put into the preservative fluid should be kept under a low temperature and in a darkened room.

Following are some of the preservative formulas:

Formalin, 1 pint.

Salt solution, 2 pints.

Water, 17 pints.

When made up, the solution will keep indefinitely. Another solution weaker in formalin has also been used here satisfactorily. The proportions are:

Formalin, 3 parts.

Salt solution, 10 parts.

Water enough to make 100 parts.

For raspberries, the following mixture is recommended:

Formalin, 1 part.

Glycerine, 10 parts.

Water, 89 parts.

Strawberries may be preserved fairly well in a saturated solution of common salt, and, better still, in a fluid composed of formalin, 1 ounce; alum, 1 drachm; glycerine, 5 ounces; water, 3 pints.

Red currants keep best in a solution of

Corrosive sublimate, 1 part.

Glycerine, 10 parts.

Water, 90 parts.

The corrosive sublimate must be dissolved in hot water and the solution and fruit preserved in it should be labeled poison, as it is very deadly if swallowed.

The glass stoppers of bottles and jars may be made perfectly tight by smearing the ground surface with a small amount of light-colored vaseline. This will also prevent in great measure the sticking of the stoppers when it is desired to remove them.

Produce in Transit, Control of. See *Reduction of Waste in Marketing*, p. 1327.

Propagation of Fruits

Particular Methods by Which Various Fruits are Multiplied

Barberry—Cuttings of mature wood; seeds.

Orange—Seeds; seedlings budded or grafted.

Figs—Cuttings, either of soft or mature wood.

Mulberry—Cuttings of mature wood. Some varieties are root-grafted and some are budded.

Olive—Cuttings of mature or even old wood. Chips from the trunks of old trees are sometimes used.

Pomegranate—Cuttings, layers and seeds.

Apple and pear—Seeds; seedlings budded or grafted.

Peach and other stone fruits—Seeds; seedlings budded. Peach trees are sold at one year from the bud, but other stone-fruit trees are planted when two or three years old.

Quince—Cuttings usually; the cuttings often grafted.

Grape—Cuttings of from one to three buds; layers.

Currant and gooseberry—Cuttings.

Raspberry, red—Suckers from the root; root cuttings.

Raspberry, black—Layers from tips of canes; root cuttings.

Blackberry—Root cuttings; suckers from the root.

Dewberry—Layers of tips of the canes; root cuttings.

Dwarf Juneberry—Sprouts or suckers from the root.

Cranberry—Layers or divisions.

Strawberry—Runners; tip cuttings.

Stocks Used for Various Fruits

Almond—Peach, hard-shelled almond, plum.

Apple—Common apple seedlings, Paradise and Doucin stocks, crabapple and wild crab.

Apricot—Apricot and peach in mild climates and plum in severe ones. Marianna.

Cherry—Mazzard stocks are preferred for standards; mahaleb stocks are used for dwarfing. The wild pin cherry *(Prunus pennsylvanica)* is sometimes used as stock in the Northwest on account of its hardiness. Seedlings of Morello cherries are also used there.

Medlar—Hawthorn, medlar, quince.

Mulberry—Seedlings of white and Russian mulberry; cuttings of Downing.

Orange—Seedlings; Otaheite orange; shaddock; *Citrus trifoliata*, particularly for dwarfs.

Peach and nectarine—Peach. Plum is often used when dwarfs are wanted, or when the peach must be grown in a too severe climate or upon heavy soil.

Pear—Pear (seedlings of common pear and the Chinese type). Quince (rarely mountain ash, or thorn) for dwarfs. Apple temporarily.

Persimmon, Japanese—Native persimmon.

Plum—Plum, myrobalan plum; peach; marianna.

Quince—The finer varieties are sometimes grafted upon strong-growing kinds like the Angers. When cuttings are difficult to root, they are sometimes grafted upon apple roots, the foster root being removed upon transplanting if it does not fall away of itself.

Bailey's Rule Book, pp. 127, 128.

Prune

H. C. Atwell

The prune is supposed to have been introduced into France from Turkey or Persia near the close of the Crusades. The bulk of the European product is grown in France and Bosnia. The prune industry of the United States is mostly confined to the Pacific coast. In California the variety of commercial importance is also that most extensively grown in France. It is known on this coast as the French or Petite prune, although in the American market it is termed the California prune. This variety flourishes especially in the Umpqua valley of Oregon. In other portions of the Pacific Northwest the larger, darker-colored and more acid Italian prune, known in the East as the Fellenberg plum, is more generally grown, and finds a very congenial environment. Its culture here has become an important industry, second only to the apple among fruits. In the arid districts of the Pacific Northwest the bulk of Italians are shipped fresh, and are known to the trade as plums.

In the Willamette valley and portions of Western Washington, notably Clarke county, this fruit is almost exclusively dried in evaporators and has become the leading pomological product. It is known commercially as the Oregon prune, and is driving the smaller and sweeter Petite from many markets. In the Pacific Northwest the prune is almost universally worked on peach roots. This practice is approved by most growers, although it limits successful prune culture to well-drained soils. Only yearling trees are planted. Experience has demonstrated that trees should not be planted closer than 20 feet. Clean cultivation, with an occasional turning under of a leguminous crop, after bearing age is reached, is general practice. The Italian prune thins itself. The prune makes the best evaporated article if left on the tree until fully ripe. They are not gathered until a considerable quantity have fallen. Four or five gatherings are made always from the ground, the trees being lightly shaken during the latter part of the season. At the evaporator the fruit is rinsed, dipping for a few seconds in boiling lye, spread upon wire-bottom trays and placed in the kilns. The dipping facilitates drying, by checking the outer skin, thus allowing more rapid evaporation of moisture. Italians are evaporated in from 30 to 36 hours and Petites in 18 to 24. The shrinkage of Italians in drying is about two-thirds, of Petites somewhat less. After being dried the fruit is allowed to sweat in bins for a few weeks, being graded according to size into 30-35, 35-40, etc., according to the number required to make a pound.

Most of the crop is handled by Pacific Northwest distributors, who regrade, steam and pack in boxes while hot. The evaporated prune is pronounced by experts to be one of the most nutritious and healthful food products.

Evaporating Prunes

Evaporators used in the Northwest are of two general types, the tunnel and the stack, both having warm advocates. In the hands of a competent operator both

appear to do equally efficient work, and at no appreciable difference of cost. There have been some new styles placed upon the market, but so far as I can learn they are unsatisfactory. The majority of our growers are satisfied with the types in use for the past 15 years.

The tunnel dryer consists of tunnels, whose inside measurements range around 30 inches in width and four and a half feet in height. In them are placed trays, usually of galvanized woven wire spread on a wooden frame. These trays are placed either on cars or on rows of porcelain insulators attached to sides of tunnel. Nine trays are placed on a car, spaces between the trays being wider at the bottom and gradually decreasing toward the top. About the same distance between trays is observed when they are placed on insulators. Tunnels vary in length from 18 to 36 feet. The end farthest from the furnace is made higher than the other end. The difference in height of ends varies according to length of tunnel and views of architect. My 36-foot tunnels had a difference of four feet. The fruit is placed in the upper end, and a car or tray of done fruit is removed at the lower end. The greener fruit advances toward the heat.

The stack dryer consists of a stack of trays placed one above the other to a height convenient to be reached from the operating floor. In the most uniform styles of this type it is arranged so that pressure of upper trays can be lifted from the lower tray. The latter is then withdrawn when its fruit is sufficiently dried. The trays above are then mechanically let down to take its place, leaving room at the top for inserting a fresh tray. Four tunnels or 16 stacks (eight on each side) are considered about the proper limit for one furnace.

With all dryers there must be a lower story for accommodation of the furnace and pipes. For safety from fire a space of at least eight feet should intervene between the furnace and the floor of the stack or tunnel. A side hill affords best location for a dryer, as it allows room for the lower story without having to build a platform driveway to reach the main floor. A temperature of about 180 degrees, at the point where the heat emerges from the furnace room into the kiln, produces best results. Hop stoves of specially durable construction, or steam boilers fitted up for the purpose, are more satisfactory than brick furnaces. It is very difficult to keep the latter in safe condition. The pipes are confined to the furnace room and are designed mainly to assist the furnace in radiating heat. A large area of radiating surface in the pipes is therefore desirable. Sixteen-inch pipe is a common size. From three-fourths to a cord of fir wood is consumed in turning out a ton of dried prunes. Mr. A. C. Goodrich, of Yamhill, Oregon, member of the Oregon State Board of Horticulture, has recently fitted out an apparatus for burning oil. This requires no change in construction of evaporator. He tells me that the oil is cheaper than fir wood at $3.50 a cord, and has the further advantage of making it possible to maintain a uniform temperature, regardless of weather conditions. This cannot be done with wood for fuel.

Twenty-eight to 30 hours is the average time required for drying Italian prunes, depending on ripeness and weather conditions. Evaporation is much more rapid on a clear, warm day and in absence of wind.

Apples require considerably less time to dry than prunes. All prunes should be dipped in boiling lye before being subjected to the drying process. A dipping vat containing boiling lye is provided. Into this a wire basket holding about a half bushel of fruit is immersed two or three times and for only a few seconds. The same basket is then dipped into various rinsing tubs of cold water and the contents of the basket are then emptied upon a tray to be spread.

There are satisfactory appliances in use by which the operations of dipping, rinsing and spreading are accomplished with a minimum of hand labor. The object of dipping in the lye is simply to facilitate evaporation by checking the

outer skin, making it easier for the moisture in the fruit to escape when subjected to heat. If left too long in the lye the checking will extend into the flesh of the fruit. This is very undesirable. If properly dipped and rinsed no trace of lye is left on or in the fruit.

Another object in dipping is to remove dirt, as our prunes are allowed to ripen and fall upon the ground before being gathered for the dryer.

Evaporation of fruit is not a complex process, nor is it difficult to acquire skill in the work in a short time. It affords a promising outlet for lower-grade fruit, and may be made a valuable adjunct to the business of shipping fresh fruit. I look for a large increase in use of the evaporators in the Pacific Northwest.

Future of the Prune Industry in Oregon

*Fifteen and twenty years ago the prune industry was overdone in the Northwest. This was due to the fact that prunes were often planted under conditions that were not congenial. We did not understand handling the product properly. Often the prunes were dried too much, and again the product was rough and very unattractive in appearance; a great deal of the product was insufficiently dried, so that it became mouldy and decayed, and we tried to force this then unknown product upon the world's markets.

The present outlook for the prune is very encouraging, and more people should become interested in this industry. It offers one of the most attractive investments in this state at the present time. It can probably be said that when one considers the cost of land, cost of production, etc., the prune offers one of the most attractive investments to be found in Oregon. One of the prominent prune men this year remarked that we could have sold twice as many prunes as we had without lowering the price. The present indications are that the prune will pay larger dividends in the future than they are even paying today.

The world's markets are thoroughly familiar with the Oregon prune, and are demanding more and more of the fruit. They are easy to handle and can be put up in an attractive way.

The principal prune grown in Oregon is the Italian, though some Petite, Hungarian, Silver, etc., are grown. At The Dalles and parts of Eastern Oregon like Cove, prunes are raised largely for shipping green. In the Willamette and Umpqua valleys the prunes are raised principally for evaporating purposes, although much of the product is being shipped green. Undoubtedly years of light prune crops in the East will find trainloads being shipped green from the valleys of Western Oregon. Salem is perhaps the center of the prune district, although one finds large areas in the vicinty of Newberg, Sheridan, Dallas and other cities.

The prune likes a well-drained loam, and does especially well on rolling foothills when deep and provided with good air and soil drainage. While they can be planted 15 to 16 feet apart at the time the orchard is set, by the time the trees come into heavy bearing they will need greater distance—probably 25 feet would not be too great a distance at which to plant. The ground should be given especially good preparation in the spring, followed by frequent summer cultivation. Where extra good care is given up to the middle of July many of the growers cease cultivation from that time on, claiming that by this method they get a standard prune and one with tender skin. This can be done only where good care has been given to the orchards during the spring months.

Prunes are allowed to drop upon the ground and are picked up in boxes. Generally five cents a box is paid for such work. They are then usually dipped in boiling water, rinsed in cold water and graded. The fruit is then placed on trays and put in a dryer, where evaporation takes place. There are many types of dryers. Average heat is started at from 80 to 120 degrees and gradually increased to 180 degrees. It will generally take about 36 hours to dry prunes well. After drying, the fruit is taken to the packing

* Oregon Experiment Station Bulletin 111.

house, where it is well graded and very thoroughly cleansed and sterilized by steam; it is then packed according to size in boxes for the market.

PRUNE DISEASES

Prunes are subject to some of the same diseases as plums, peaches and other stone fruits. The reader will find diseases and pests of prunes listed under these various fruits.

Bacterial Black Spot

Pseudomonas pruni Sm.

This disease has the same generic origin as the crown gall but is widely different in nature. It attacks the green fruits which show conspicuous black-purple sunken spots, sometimes as large as half an inch in diameter. It has been observed upon triflora plums only, and is not serious.

Black Spot. See *Scab* under *Peach Pests.*

Leaf Curl. See *Peach Diseases.*

Mushroom Root Rot. For description of this disease see *Apple Diseases.*

Prune Mushroom Root Rot.

Peach Scab or Black Spot. See *Peach Diseases.*

PRUNE PESTS

Black Scale. See *Apricot Pests.*

Brown Day Moth

Pseudohazis eglanterina Boisd.

(Family *Saturniidae*)

General Appearance

The eggs are salmon-colored and laid in clusters around small stems or branches. The larvae are dark or nearly black with fine lateral red stripes and spots on the dorsum. The bodies are covered with long tufts of black and light-brown hairs. When full grown they are a little over two inches long. The chrysalids are dark reddish-brown and about one inch long. The adults are beautiful yellow moths blended with red or salmon color and regularly marked with black. The thorax is deep orange; the dorsal half of the abdomen is yellow and the central half red. A black band encircles each segment. The posterior end has a long tuft of yellow and red hairs. The antennae of the female are orange, and brown in the male. The legs are yellow with black spines.

Life History

The eggs are deposited in the spring of the year upon various fruit trees, wild trees and bushes. The young attack the foliage, almost entirely defoliating the plants. When full grown the larvae seek the ground, where they pupate and thus pass the winter, emerging early in the spring as adults. These are often seen flying during the day.

Food Plants

This species attacks a great variety of both wild and cultivated trees and shrubs. Prune trees have often been severely attacked, the young larvae destroying the first appearing buds.

Control

The egg masses are very conspicuous and great numbers of them may be easily destroyed by hand picking in the spring.

Arsenical sprays applied when the larvae become apparent are also effective.

Natural Enemies

Internal humenopterous parasites perform a very important role in checking the ravages of this pest. Caterpillars are often found with the cocoons of these

Fig. 1. Brown Day Moth in Its Various Stages.

parasites attached to the bodies. The eggs are also destroyed in large numbers by small parasites. E. O. Essig

Citrus Red Spider. See *Apple Pests* under *Red Spider.*

Clover Mite. See *Clover Pests.*

Common Cutworm. See *Cabbage Pests.*

European Fruit Lecanium

Lecanium corni Bouche

H. F. Wilson

In Oregon we have found this pest on prune only, and how bad a pest it may get to be is hard to say. It also attacks peaches and apricots as well as a large number of non-fruit trees. In California it is known as the brown apricot scale, because it seriously attacks apricot trees.

The adult females are brownish in color with a few black markings, convex in shape and oftentimes covered with a white powdery secretion. They measure about one-eighth inch in length, are slightly less than that in width and are raised about one-sixty-fourth of an inch. (See Fig. 1.)

Remedies

Lime-sulphur is not very efficient against this insect, and should the insect become a serious pest it will be necessary for us to adopt what is known as the Distillate-oil Emulsion Spray, which is made as follows:

Hot water	12	gals.
Fish Oil Soap	30	lbs.
Distillate oil (28° Baume)	20	gals.

The fish oil soap is made as follows:

Water	6	gals.
Lye	2	lbs.
Fish oil	1½	gals.

The soap ingredients should be boiled for about two hours and produce about 40 pounds of soap. Use this at the rate of six per cent distillate emulsion by taking 5½ gallons of the concentrated emulsion and 44½ gallons of water. Add one pound of caustic soda to soften the water. In mixing the original solution it should be driven through a force pump and back into the containing vessel in the same manner as kerosene emulsion is mixed.

Fig. 1. The European Fruit Lecanium. (Original.)

Natural Enemy

Comys Fusca.

Fall Canker Worm. See *Apple Pests.*

Frosted Scale. See *Apricot Pests.*

Fruit-Tree Pulvinaria

Pulvinaria amygdali Ckll.

General Appearance

The general appearance of this insect is well shown in Fig. 1. The body proper is yellowish to brownish and the large egg-sac white. The entire length, including egg-sac, is nearly one-half inch.

Food Plants

The foliage of the prune and peach trees.

E. O. Essig

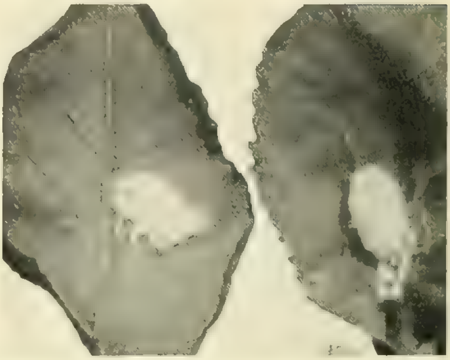


Fig. 1. The Fruit-Tree Pulvinaria (*Pulvinaria amygdali* Ckll.). (Natural size.)

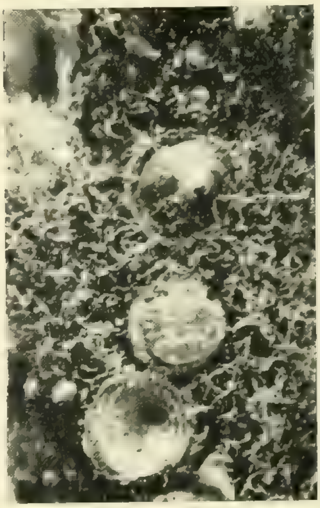
Mealy Plum Louse. See *Plum Pests.*

Peach Borer. See *Peach Pests.*

Pear Thrips. See *Pear Pests.*

Red Humped Caterpillar. See *Apple Pests.*

San Jose Scale. See *Apple Pests.*



San Jose Scale on Prune greatly magnified (Purdue Experiment Station.)

Spring Canker Worms. See *Apple Pests.*

White Peach Scale. See *Peach Pests.*

Publications

Reference List on Fruit Growing

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Introductory

* This list is prepared largely to meet the needs of those actively engaged in fruit growing, or about to engage in it, who desire to know more of the best present-day methods and of the means for keeping in touch with advances as they are made. The list also contains some references of a more technical character, that may be of value to the investigator.

The following lists are obtainable, on request, from the Secretary of Agriculture, Washington, D. C.:

1. List of publications of the Department of Agriculture available for free distribution. Circular 2, Division of Publications.

2. List of publications of Department of Agriculture for sale. Circular 3, Division of Publications.

3. Enrollment on mailing list to receive:

   a. Monthly list of publications.

   b. List of station publications received at the office of experiment stations.

For those desiring additional and fuller information on agricultural and kindred publications throughout the world, with brief abstracts of the more valuable articles, the Experiment Station Record is available. It is now issued in two volumes a year, eight numbers each, at $1.00 per volume, payable in advance to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Department Bureaus

The various divisions of the U. S. Department of Agriculture are found on page 665.

Their *free* publications are obtainable on request from the Secretary of Agriculture, Washington, D. C.; and those for sale are obtainable from the Superintendent of Documents, at prices indicated in Circular 3, mentioned above.

* Pennsylvania Experiment Station Bulletin

Experiment Stations

The addresses of the various experiment stations and their directors are found on page 934.

Their publications may be obtained, so far as available, by writing the directors or stations direct, or by writing the author of the desired publication at the station address.

Horticultural Societies

The reports of horticultural and other organizations referred to in the following list are obtainable at moderate cost, so far as available, from the sources indicated below:

1. Society for Horticultural Science, Secretary, C. P. Close, College Park, Md.

2. American Pomological Society, Secretary, E. R. Lake, Washington, D. C.

3. Pennsylvania State Horticultural Association, Secretary, C. J. Tyson, Floradale, Pa.

4. Western New York Horticultural Society, Secretary, John Hall, Granite Building, Rochester, N. Y.

5. New York State Fruit Growers Association, Secretary, E. C. Gillett, Penn Yan, N. Y.

6. Woburn Experimental Farm. (Reports obtainable from The Amalgamated Press, Ltd., Carmelite St., London, England.)

7. Pennsylvania State Department of Agriculture, Harrisburg, Pa.

7a. Adams County Fruit Growers Association, Secretary, C. J. Tyson, Floradale, Pa.

8. Ontario Department of Agriculture, Guelph, Ontario.

9. Canada Central Experimental Farms, Ottawa, Canada.

10. Washington State Horticultural Association, Secretary, R. E. Trumble, Wenatchee, Wash.

Periodicals

The more important periodicals relating to fruit, wholly or in part, are as follows:

1. Better Fruit. Hood River, Oregon.

2. The National Nurseryman. Rochester, N. Y.

3. The Fruit Grower and Farmer. St. Joseph, Mo.

4. The Canadian Horticulturist. Peterboro, Ontario.

5. Colorado Fruit Grower. Grand Junction, Colorado.

6. The Fruit Magazine. Vancouver, B. C.

7. The Rural New Yorker. New York, N. Y.

8. The American Agriculturist. New York, N. Y.

9. The Americulturist. Fowler, Indiana.

10. The Country Gentleman. Philadelphia, Pa.

Books

The American Garden and the Western New York Apple are referred to in the list below, but are no longer published, the articles in question being found only in certain libraries.

The books referred to below have the publishers indicated briefly in connection with the reference. The full titles and addresses of these publishers are as follows:

1. University Co-operative Association, Madison, Wis.

2. The Macmillan Co., 64-66 Fifth Ave., New York, N. Y.

3. Orange Judd Co., 439 Lafayette St., New York, N. Y.

4. Ginn & Co., 70 Fifth Ave., New York, N. Y.

5. J. B. Lippincott Co., Philadelphia, Pa.

6. Doubleday, Page & Co., New York, N. Y.

These lists are not intended to be complete in any case. Many articles were omitted purposely to avoid confusion or because of difficult availability of the reference. The articles that have seemed to the writer most important, however, have been included; and in most cases there are enough references given to permit of considerable choice and to provide against failure in obtaining any particular article.

I. STARTING APPLE ORCHARDS

Location, Variety, Selection and Purchase of Stock

The Apple in Pennsylvania: Varieties, planting and general care. Stewart. Pennsylvania Station Bulletin 106: 3-20. 1910.

Summer Apples in the Middle Atlantic States. Gould. U. S.

Orchard Practice. Green. Ohio Station Circular 108: 1-8. 1911.

Bureau of Plant Industry. Bulletin 194: 7-53. 1911.

Connecticut (Storrs) Station Bulletin 62: 97-108. 1910.

Establishing the Apple Orchard. Erwin & Bliss. Iowa Extension Bulletin 5: 4-27. 1910.

Goff's Lessons in Fruit Growing. pp. 3-13. 1902. (University Co-operative Association, Madison, Wis.)

Bailey's Principles of Fruit Growing. pp. 37-61. 1897. (The Macmillan Co., 64-66 Fifth Ave., New York, N. Y.)

Office of Experiment Station Bulletin 178, pp. 14-17. 1907.

Suggestions on Planting Orchards. White. Michigan Bulletin 262: 5-29. 1910.

Fruits Recommended by the American Pomological Society for Various Sections. Ragan. U. S. Bureau of Plant Industry Bulletin 151: 5-69. 1909.

The Ben Davis Group of Apples. Shaw. Massachusetts Station Report. 1910, pp. 176-193.

Variation in Apples. (Technical.) Shaw. Massachusetts Station Report. 1910, pp. 194-213.

Blowing Stumps with Dynamite. Roberts. Kentucky Station Bulletin 154: 19-30. 1911.

Varietal Adaptations to Soils

Wilder. American Pomological Society Report for 1909, pp. 138-143.

Wilder. Pennsylvania Horticultural Association Report for 1908, pp. 55-57.

Bonsteel. Office of Experiment Station Bulletin 178: 14-16. 1907.

Wilder. Annual Report. Pennsylvania Experiment Station, 1910-11.

Preparation of Soil, Planting Systems and Planting

Planting the Apple Orchard. Jarvis. Connecticut (Storrs) Station Bulletin 62: 109-133. 1910.

Planting the Commercial Orchard. Moore. Wisconsin Bulletin 201: 2-34. 1911.

Bailey's Principles in Fruit Growing, pp. 237-276. 1897.

Planting Systems. Craig. Western New York Horticultural Society Report. 1910, pp. 67-73.

Starting Apple Orchards. Munson West Virginia Bulletin 116: 213-248. 1908.

Apple Planting in Idaho. Judson. Idaho Bulletin 43: 321-351. 1904.

Apple Planting in Idaho. Shinn. Idaho Bulletin 64: 3-37. 1908.

Value of Different Planting Distances, N. Y. Cornell Bulletin 262: 311-312. 1909; and also Cornell Bulletins 226 and 229. 1905.

General Culture

Growing the Apple Orchard. Alwood. Virginia Bulletin 99: 53-79. 1899.

Apple Culture. Macoun. Central Experimental Farm (Canada), Bulletin 37: 7-74. 1901.

Apple Culture. Hutt. Ontario Department of Agriculture Bulletin 144: 2-37. 1905.

Intercrops

Bailey's Principles of Fruit Growing. pp. 170-172. 1897.

Interplanting. Jarvis. Connecticut (Storrs) Station Bulletin 62: 135-137. 1910.

Pennsylvania Department of Agriculture Report, 1908. Roberts, pp. 502-4.

Intercropping (and note on planting hillside orchards). Stewart. Pennsylvania State Horticultural Association Report. 1908. pp. 48-50.

Intercropping of Young Orchards. Watts. Report for 1909 of the Fruit Growers' Association, Adams County, Pa., pp. 53-61.

II. CULTURAL METHODS AND COVER CROPPING

Cultivation and Cover Crops. Green, S. B. Office of Experiment Stations Bulletin 178: 19-23. 1907.

Control or Moisture in Orchard Soils. Shutt. American Pomological Society Report. 1909: 32-41.

Tillage: Methods, Implements and Purposes

Principles and Practice of Earth Mulches. King. Rural New Yorker, July 2, 1910, pp. 689-90.

Cultivation of Orchards. Bailey. New York Cornell Bulletin 72: 299-314. 1894.

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New York Cornell Reading Course for Farmers. Craig. Ser. III. No. 3, 1903.

Mulching

Mulching. U. S. Department of Agriculture Farmers' Bulletin 202: 8-12. 1904.

Grass Mulch. Vergon, F. P. Rural New Yorker, No. 2874, 1905, pp. 137-38.

Collingwood. Rural New Yorker, Oct. 23, 1909, p. 921; Oct. 30, 1909, p. 941.

The Apple in Pennsylvania. Stewart. Pennsylvania Station Bulletin 106: 3-20. 1910.

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Cost of Growing New York Apples. Burritt. Rural New Yorker, 1911, pp. 733, 734.

Orchard Management. C. I. Lewis. Oregon Experiment Station Bulletin 111. 1911.

Experiments on Relative Value of Different Methods

Experiments in Orchard Culture. Emerson. Nebraska Bulletin 79: 3-33. 1903. (Abstract) in U. S. Department of Agriculture Farmers' Bulletin 202: 16-17. 1904.

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A Comparison of Tillage and Sod Mulch in an Apple Orchard. Hedrick. N. Y. Geneva Bulletin 314: 77-132. 1909. (Abstract by Hall in popular edition of Bulletin 314).

Experiments with Cultural Methods. Stewart. Pennsylvania Station Bulletin 100: 17-28. 1910.

Tillage vs. Sod Mulch in Apple Orchards. U. S. Department of Agriculture Farmers' Bulletin 419: 5-10. 1910. (A brief general review of Nos. 9 and 12 above.)

Cultural Methods for Orchards. Burrill & Blair. Illinois Bulletin 52: 105-127. 1898.

Effect of Grass on Trees. Pedford & Pickering. Woburn Experimental Fruit Farm Report, 1903; also Journal of Agriculture Science (England), 1908, pp. 411-434; and Nature (London), 1907, No. 1962, pp. 126-127.

Orchard Survey of Niagara County. Cummings. N. Y. Cornell Bulletin 262: 295-300. 1909; also compare Cornell Bulletins 226 and 229. 1905.

An Apple Orchard Survey of Ontario County. Miss H. M. Martin. Cornell Bulletin 307: 169-215. 1911.

III. ORCHARD COVER CROPS AND IRRIGATION

A. Cover Crops

General Considerations

Craig. In Cyclopedia of American Horticulture. Vol. I, p. 388. 1905. (Doubleday, Page & Co.)

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X. SPRAY MATERIALS: PREPARATION, USE, MACHINERY, LEGISLATION, ETC.

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Vegetable Culture

Books:

ABC of Potato Culture. Terry. 45 cents.

Asparagus Culture. Hexamer. 50 cents.

Cabbage, Cauliflower and Allied Vegetables. Allen. 50 cents.

Celery Culture. Beattie. 50 cents.

Gardening for Profit. Henderson. $1.50.

Gardening for Pleasure. Henderson. $1.50.

Garden Making. Bailey. 75 cents.

How to Make the Garden Pay. Greiner. $1.00.

Mushrooms, How to Grow. Falconer. $1.00.

Melon Culture. Troop. 50 cents.

New Onion Culture. Greiner. 50 cents.

New Rhubarb Culture. Morse and Fiske. 50 cents.

Principles of Vegetable Gardening. Bailey. $1.50.

Tomato Culture. Tracy. 50 cents.

Vegetable Gardening. Watts. $1.75.

Success in Market Gardening. Rawson. $1.10.

Sweet Potato Culture. Fitz. 50 cents.

Insects Injurious to Vegetables. Chittenden. $1.50.

Vegetable Gardening. Watts. $1.75.

Periodicals:

The Garden Magazine, Garden City, N. Y., per year, $1.50.

The Market Growers' Weekly Journal, Louisville, Ky., per year, $1.00.

The Vegetable Grower, Chicago, Illinois, per year, 50 cents.

Farmers' Bulletins, U. S. Department of Agriculture:

Asparagus, No. 61.

Beans, No. 289.

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Celery, No. 282.

Frames as Factor in Truck Growing, No. 458.

The Home Vegetable Garden, No. 255.

Mushrooms, Culture of, No. 204.

Onion Culture, No. 354.

Sweet Potatoes, No. 324.

Tomatoes, No. 220.

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Greenhouse Management and Floriculture

Books:

Commercial Violet Culture. Galloway. $1.50.

The Forcing Book. Bailey. $1.25.

Greenhouse Construction. Taft. $1.50.

Greenhouse Management. Taft. $1.50.

Practical Floriculture. Henderson. $1.50.

The American Carnation. Ward. $3.50.

The Chrysanthemum. Herrington. 50 cents.

The Rose. Ellwanger. $1.25.

Periodicals:

The Florists' Exchange, New York City, per year, $1.00.

The Florists' Review, Chicago, Illinois, per year, $1.00.

The American Florist, Chicago, Illinois, per year, $1.00.

Farmers' Bulletins, U. S. Department of Agriculture:

Propagation of Plants, No. 157.

Annual Flowering Plants, No. 195.

Landscape Gardening

Books:

Landscape Gardening. Parsons. $3.50.

Landscape Gardening. Waugh. 50 cents.

Lawns and How to Make Them. Barron. $1.17.

What England Can Teach Us About Gardening. Miller. $4.32.

Periodicals:

Country Life in America, New York City, per year, $4.00.

Park and Cemetery, Chicago, Illinois, per year, $1.00.

Farmers' Bulletins, U. S. Department of Agriculture:

Beautifying Home Grounds, No. 185.

Tree Planting in School Grounds, No. 134.

PUGET SOUND, EARLY ORCHARDS OF. See *History of Orcharding in Old Oregon.*

Pumpkin

The pumpkin is a well-known product of American farms, generally grown in corn-fields in the same area as the corn. Sometimes it is grown as a separate crop, as food for stock, or occasionally in large quantities for the markets. It is easily grown and reasonably profitable. The scientific name is *Cucurbita pepo*, a species of the gourd family, and is largely cultivated in Europe as well as in America. The pumpkin varies much in form, color and size. We have seen the larger kinds weighing 75 to 100 pounds; but the smaller varieties are best for home use. When ripe the pumpkin is boiled, baked, or made into various kinds of pie, butter or sauce. It is difficult to keep any particular variety of pumpkin from mixing with other varieties, if they are grown closely enough together for the bees to carry the pollen from one to another. When mature, if they are gathered in the autumn before freezing and stored in a cool place, they may be kept for winter use. Certain varieties will keep until late in the season. With the early pioneers of the United States it was an important article of food, because it was healthful, nutritious, productive and cheap; also because other fruits, such as

apples, peaches and pears, were of slower growth and required more labor to produce them.

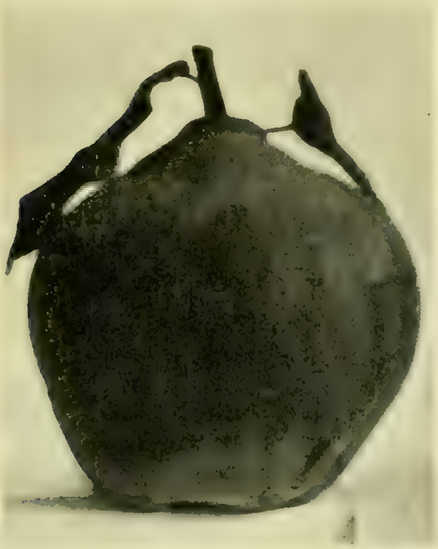
GRANVILLE LOWTHER

DISEASES AND PESTS

The pumpkin is attacked by the same list of diseases and insect pests, for the most part, as squash, cantaloup, cucumber and other cucurbitious crops. The various subjects in this department will be found under those plants.

PYRUS. See *Apple, Botany of.*

Quince



Mammouth Quince.
- *Maxted Photo.*

The common quince is a native of Persia and Anatolia, and perhaps also of Greece and the Crimea, but in these latter localities it is doubtful whether or not the plant is not a relic of former cultivation. By Franchet and Savatier *Pyrus cydonia* is given as a native of Japan, with the native name of "maroumerou." It is certain that the Greeks knew a common variety upon which they engrafted scions of a better variety, which they called *Kydonion*, from Cydon, in Crete, whence it was obtained, and from which the later names have been derived. Pliny (H. N. XVII) mentions that the fruit of the quince, *Malum cotoneum*, warded off the influence of the evil eye; and other legends connect it with ancient Greek mythology, as exemplified by statutes in which the fruit is represented, as well as by representations on the walls of Pompeii. The fragrance and astringency of the fruit of the quince are well known, and the seeds were formerly used medicinally for the sake of the mucilage they yield when soaked in water, a peculiarity which is not met with in pears. This mucilage is analogous to, and has the same properties as, that which is formed from the seeds of flax.

The quince is but little cultivated, two or three trees planted in the slip or orchard being in general found to be sufficient for a supply of the fruit. The fruit has a powerful odor, but in the raw state is austere and astringent. It, however, makes an excellent preserve, and is often used to give flavor and poignancy to stewed or baked apples.

There are three principal varieties of the quince—the Portugal, the apple-shaped and the pear-shaped. The Portugal is a taller and more vigorous grower than the others, and has larger and finer fruit; the apple-shaped, which has roundish fruit, is more productive, and ripens under less favorable conditions than either of the others; while the pear-shaped has roundish-pyriform fruit, which ripens later than that of the apple-shaped variety.

The quince prefers a rich, light and somewhat moist soil. The tree is generally propagated by cuttings or layers, the former making the best plants, but being longer in growing. It is much used as a dwarfing stock for certain kinds of pears, and for this purpose the young plants when bedded out should be shortened back to about 18 or 20 inches; the effect is to restrain the growth of the pear, increase and hasten its fruitfulness, and enable it to withstand the effects of cold. Those required to form standard fruit-bearing trees should be trained up to a single stem till a height of five or six feet is attained.

The common Japan quince, *Cydonia*, or

Pyrus japonica, is grown in gardens for the sake of its flowers, which vary in color from creamy white to rich red, and are produced during the winter and early spring months. The fruit is green and fragrant but quite unedible. *Cydonia maulei*, a more recently introduced shrub from Japan, bears a profusion of equally beautiful orange-red flowers, which are followed by fruit of a yellow color and agreeable fragrance; so that, when cooked with sugar, it forms an agreeable conserve, as in the case of the ordinary quince.

QUINCE DISEASES

The quince is attacked by the diseases and pests common to apple and pear; and, for the most part, they will be found listed under those heads.

Anthracnose

H. S. Jackson

Mr. C. C. Cate, formerly assistant in plant pathology at the Oregon Agricultural College, records the presence of apple tree anthracnose as a disease of the quince. The writer has also observed this disease upon several occasions in the vicinity of Corvallis, first in the fall of 1909. We are informed by W. H. Lawrence that he found the disease quite common in the Hood River valley in the fall of 1911. It is apparently not infrequently found on the fruit, particularly in seasons of early fall rains. It also causes small cankers on the branches and twigs. No experiments looking toward the control of this disease on the quince have been carried out, but it is probable that fall spraying with Bordeaux mixture, as for the apple, would control the trouble. Apple trees in the vicinity of quinces should be protected by fall spraying in order to prevent the disease from spreading to the quinces.

Fire Blight

The disease known as fire blight (See *Blight*, under *Pear Diseases*), is also known to attack the quince. In districts where fire blight is prevalent, quinces should be inspected as carefully as apples and pears, and the treatment recommended for the control of the disease on those crops should be followed out.

Black Knot, or Crown Gall. See *Crown Gall*, under *Apple Diseases*.

Leaf Blight

Entomosporium maculatum

H. S. Jackson

In rainy seasons the leaf blight of the quince, due to *Entomosporium maculatum*, which causes spots on the foliage and fruit, is occasionally found in Oregon, though it is seldom serious. This disease may be controlled by spraying with Bordeaux mixture, first as soon as the petals fall, followed by two applications at intervals of two weeks.

Little Leaf. See *Peach Diseases*.

QUINCE PESTS

Greedy Scale. See *Apple Pests*.

Green Apple Aphids. See *Apple Pests*, also *Aphids*.

Oyster Shell Scale. See *Apple Pests*.

Pear Slug. See *Pear Pests*.

San Jose Scale

Fig. 1. San Jose Scale on Quince Leaves. For control see under *Apple Pests*. —*Purdue Experiment Station.*

Scurfy Scale. See *Apple Pests*.

Radish

The radish belongs to the mustard family (*Cruciferae*), and has a fleshy, pungent root. Radishes are commonly eaten raw, with salt. The radish grown for summer use is an annual, while the winter radish is a biennial. The flower stalks are branched about three feet high, and have white or lilac-colored flowers, but never yellow. The seed is two or three times larger than the turnip seed and more variable in size. It is claimed from experiment stations that the larger seeds germinate better and produce better roots than the smaller.

Culture

Radishes are easily cultivated, are vigorous growers and the roots of some of the earliest varieties, under favorable conditions, may be ready for use in three weeks after planting. The plants are frost-resistant in considerable degree, and may be sown earlier than many other vegetables, for early use. The small turnip-rooted variety is one of the earliest, but seed may be sown at any time during the season, for fresh, tender roots a few weeks after sowing. Seeds are usually planted in drills, and thinned to the proper distance.

Winter radishes are grown in much the same manner as turnips and may be stored in pits or cellars. For this kind the seed is sown in June or July, or, in the Southern states, in August, and for this purpose the larger rooted varieties are generally planted.

Varieties

Varieties differ greatly in size, color, form, texture and taste. The following are among those in common use:

French Breakfast.—This variety is small, but one of the best very early kinds for the markets. It is not desirable for home use, because it remains in good condition but a short time, and the average family will not consume them fast enough to save the main crop. When grown for the market this objection does not obtain.

Early White-Tipped Scarlet.—This is a turnip-shaped variety, handsome, round, early, and matures very quickly.

Early Deep Scarlet.—This variety is just what its name indicates—early in maturity, and deep scarlet in color.

Long Scarlet Short Top.—A variety having long roots, scarlet in color.

White Strasburg.—Grows to a medium length, flesh white and tender, and one of the best for summer use.

Rose.—The skin of this variety is of a pinkish color, and it is one of the most popular for winter use.

Black Spanish.—The skin of this variety is very black, flesh white, firm, tender, but very hot, biting and pungent. It is a winter radish and, for certain purposes, considered very good.

GRANVILLE LOWTHER

RADISH DISEASES

The following diseases of radish will be found under *Cabbage Diseases*.

Black Rot, Club Root, Damping Off, Downy Mildew, White Rust.

RADISH PESTS

The following pests of radish will be found under *Cabbage Pests*.

Cabbage Worm, Harlequin Cabbage Bug, Hop Flea Beetle, Radish and Cabbage Maggot.

BEAN THRIPS. See *Bean Pests*.

Garden Slug

A. L. LOVETT

Limax agrestis Linn. (?)

The garden slug, during a protracted wet spell, is a most annoying and destructive pest of garden crops. These repulsive, slimy, slow moving creatures are usually termed snails, but are properly called slugs.

There are several species of slugs and some snails which attack cultivated crops. Slugs occur all over the world but are more abundant and a more injurious pest in humid climates; their size and habits make it very easy for them to be transported from place to place. The one under discussion, if *Limax agrestis*, is an imported species.

The host plant list is a long and varied one. A variety of greenhouse plants are

attacked, also many ornamental shrubs in the field. In garden and truck fields almost all crops may serve as hosts. The *Cruciferae* seem the favorite host, cabbage especially, and radishes to almost the same extent. Beets, beans, peas, corn and potatoes all suffer. Field crops of hops, wheat, clover and rape are common hosts. The small fruits are also attacked, strawberry plants often being injured severely during a wet season.

These pests locate at the surface of the soil, where they feed on the host and sap its energy. The feeding punctures thus formed afford a ready means of entrance for a decay that soon renders the plant worthless. I have found them feeding on the radish at a depth of three inches. During the night they come above ground. It is at this time that they attack the leaves of plants, often climbing up to the foliage of certain of the bush fruits. Young cabbages suffer most. Whatever the host, the evidence that this slug is the offender may usually be found in the coating of mucous left behind. Entire plantings are often devoured or rendered worthless by this pest, and no season passes that the slugs do not collect a heavy toll. Dry weather checks their feeding, but does not cause them to cease operations entirely. At any time when the soil is again moist, they may appear in numbers.

Natural Enemies

Birds are probably the greatest natural check we have for the control of the slugs. The thrush is especially fond of them. Moles and shrews also feed on these slimy creatures. Certain of the Carabid beetles and their larvae have been found feeding on the slugs. Centipedes also attack them occasionally. Domestic fowls will feed on the slugs and may sometimes be used to advantage in checking them.

Control Measures

With such a variety of host plants as is enjoyed by this slug, and because of its general habits, it is necessary to practice both preventive and remedial measures for its control.

Preventive Measures

Remove the refuse tops, stumps, etc., after the crop is gathered. Clean up all weeds and trash about the fields and in fence corners. In my observations the point from which the original infestations seemingly took place was a strip of stinging nettles (*Utrica lyalli*), about the borders of the field. The slugs occurred in the dense, cool growth all the season and in all stages of development.

Traps, consisting of pieces of board, sacking and similar materials may be placed about the field. The slugs will collect under these in the early morning and may be gathered up in a salt-water solution or otherwise destroyed.

Remedial

Air-slaked lime ten parts, hellebore one part, or air-slaked lime five parts and tobacco dust one part, are both very good and would possibly prove efficient.

The arsenical sprays, applied as an under spray, are worthy of trial.

The air-slaked lime alone is unsatisfactory for our conditions west of the Cascades. Crude carbolic acid emulsion is not satisfactory.

Salt, air-slaked lime and salt, air-slaked lime 96 parts and caustic soda 4 parts, and tobacco dust, are among the materials recommended by various authors which seem to give very fair success.

Drippings are recommended by one authority, who suggests rubbing the grease over the underside of well grown cabbage leaves and distributing them about the field. The grease proves very attractive to the slugs, which gather here in numbers and may be collected. It would seem that an arsenical poison might be added to drippings and the leaves thus serve as a poisoned bait.

Poison Bran Mash—consisting of coarse bran 16 pounds, Paris green 1 pound, salt ½ pound, cheap syrup 1 gallon, and warm water to make a coarse mash. is good for cutworms and should prove equally effective for the garden slug. The material may be placed in small heaps about the base of the host plants.

Turnip Leaf-Miner

Scaptomyza flaveola

Clip infested leaves and burn.

RAPE AND TURNIPS FOR COVER CROPS. See *Apple Orchard Cover Crops.*

Raspberry

The first historic account we have of the raspberry is from the Greeks, who traced its origin to Mount Ida, where it grew wild, and from which fact it received its name, *Rubus idaeus*.

Paladius, a Roman agricultural writer of the fourth century, mentions it as one of the cultivated fruits. From the gardens of Southern Europe it has found its way all over the continent and to the United States. However, in most parts of the United States, the raspberry was found growing wild when the earliest inhabitants settled the country.

Black Caps, Showing Method of Facing the Pack.

The Soil Best Adapted

The raspberry will grow on almost any kind of soil, but has its likes and dislikes, and will succeed best on a rich, sandy or clay loam, well drained and well fertilized. Yet there are adaptations of varieties in relation to soil and climate, which must be studied in order to reach the highest degree of success.

A sodden soil, one that is sub-irrigated until it is habitually wet, or one where the water stands for any considerable time, is not adapted to raspberries. A heavy coating of barnyard manure will always increase the drought-resisting qualities of the soil as well as enrich the land.

Propagation

W. L. Howard, of Columbia, Mo., on the propagation of raspberries says:

"There are three kinds of raspberries, the reds, the blackcaps and a cross (hybrid) between the two. Red raspberries are readily propagated by means of the sprouts springing up abundantly from the roots. They may also be propagated by means of root cuttings in the manner described for blackberries. Plants of one season's growth are ready to be set in the permanent planting. The rows should be at least four feet apart and the plants three feet apart in the rows. They quickly spread and cover all the ground between the plants, and also between the rows if this space is not kept clear by regular summer cultivation.

"Blackcap raspberries are propagated entirely by what is known as 'root tips.' The old plants produce long, drooping branches, which bend over and touch the ground and take root at the tips. To take root readily the soil must be cultivated during the summer or else a shovelful of earth must be thrown over the tips of the branches in midsummer. To rapidly increase the plants by this method, it is only necessary to pinch out the terminal bud when it begins to show a tendency to take root, which will cause from three to five branches to spring out at or near the end, each of which will soon touch the ground and take root. Of course, these plants will not be as strong as a single one would be without the pinching.

"The third form of raspberry is often classed with the red raspberries, although it is the result of a cross between the reds and the blackcaps. The fruit is very much like the reds, but in its manner of propagation it is like the blackcaps. The Shaffer (or Shaffer's Colossal) and the Cardinal are the best representatives of this type. All of the plants coming from root tips are formed in the summer and have two or three months in which to grow. The following spring the rooted

Red Raspberries. 1, Sunbeam—Fruit small, round, dark red, prolific; season quite long, one of the earliest varieties; flavor poor. 2, Hansel—Fruit small, round, light red; flavor poor; season very early. 3, Miller—Fruit resembling the Cuthbert but smaller, earlier and of inferior quality. 4, Thompson's Early—Fruit rather small, roundish, dark red; poor flavor; season early.

—*Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station.*

branches may be cut off about six inches from the ground, thus leaving a handle by which to pick up the plants.

"The root tips of both the blackcaps and the hybrid form are planted in spring in well prepared soil, the rows being four feet apart and the plants set three feet apart in the rows. These plants never sprout from the roots, hence the spaces in the rows between the plants are in no danger of being taken by sprouts, but if no care is taken the rooted branches may soon cover all the unoccupied ground."

Preparation of Soil

The preparation of soil for planting is much the same as for any other crop. There is no secret about it and no peculiarity. Of course, deep plowing is good, because it makes more plant food available. Pulverizing the land with a good harrow is good, because it tends to aerate the soil and form a dust mulch on top. When this is done the land may be marked off into rows, by the check system, if the contour of the land will permit, preparatory to setting in squares. The distance of planting depends on the kind of plants, whether upright or bushy growers; the kind of soil, whether rich, medium or poor, and the amount of moisture available. In rich soil or in damp

soil the plants may be set much closer than where there is a lack of fertility or moisture.

System of Planting

Provided the contour of the land is adapted to the hill system, or, as it is sometimes called, the square system, we much prefer that method. Our preference is based upon the belief that by this system a greater amount of fruit can be produced with a given amount of labor than by the system of setting in rows.

Red Raspberries: 5, King—Fruit resembling Cuthbert in size, season, shape and quality (a good variety). 6, Ruby—Fruit small, dark red, early, of poor quality. 8, Franconia—Fruit bright red, early, good size, very poor quality. 11, Red Antwerp—Medium to large, dark red, acid, rather coarse; one of the popular early varieties; most prolific, and next to Cuthbert the most popular.

—Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station.

The land can be plowed both ways and much hoeing avoided if this system is adopted. However, in case the land is rough, uneven, or for any other reason this method cannot be made practical, then the plants may be set in rows. The distances apart may be from four feet to eight feet each way, depending on the character of the soil, the moisture, the kinds of plants and the methods of planting. The plants may be set from two to four inches deep, depending somewhat on the size of plant and its root system.

Training and Staking

Where the plants are set according to the square method, in hills, a single stake, to which the canes of the upright growers can be loosely fastened, is all that is needed. However, it is common to plant two posts, with cross-arms and wires, the wires extending along the row, one about two to three feet from the ground, another at the top of the stake, from four to six feet from the ground. The wiring method cannot be used where the plants are set to cultivate both ways.

Tillage

There is the same reason for cultivating a crop of raspberries as for cultivating any other crop. First, it keeps the land pulverized, so as to make plant food available. Second, it keeps down the weeds that would, if allowed to grow, compete with the raspberry for sustenance. A good cultivator and harrow that will fit between the rows is needed. Anyone who knows how to plow corn will know how to cultivate raspberries.

GRANVILLE LOWTHER

Pruning

The usual plan is to allow the young shoots which annually spring up from the root of the plant to grow to the height of two feet or a little more. When the shoots have attained this height the first step in the pruning of the raspberry begins by breaking off three or four inches of the topmost portion of the shoot, leaving it twenty to twenty-two inches in height. The rapidly growing, succulent shoots snap off easily between the thumb and finger, and as a rule no shears or other pruning device will be found necessary to accomplish this heading-in. As a result of the check sustained by breaking off the terminal bud, the stalk thickens, the leaves grow larger, the axillary buds near the end of the stalk increase in size, and soon lateral shoots develop from them. As a rule, five or six of the topmost buds push out and, instead of having one sturdy stalk several feet in length which would carry one-half dozen fruit clusters near its tip the succeeding season, pruning has restricted its height to 20 or 22 inches and has induced the formation of five or six lateral shoots, each of which may grow to be as much as 18 inches or more in length before the close of the season; and, instead of a single cane for fruit production, there are five or six, each of which will carry as many fruit clusters as would have been produced by the original shoot had it been left to itself. Here, then, is an example of pruning inducing fruitfulness.

The second stage in pruning the raspberry consists in cutting out all the wood which is older than the present season's growth. This pruning should be done immediately after the season's crop has been harvested. If done at this period it is easy to distinguish the fruiting wood from that which has grown during the season, and by taking out all the useless wood at this time the whole energy of the root is reserved for the new growth which is to supply the crop next season. For cutting out this wood a special implement is made. A cutting edge is provided at the end of a long handle which reduces to a hawk-bill knife. It also contains a chisel-shaped portion at the back of the hook. In one case the implement serves the purpose of a brush hook on a small scale and in the other when the chisel blade is used it serves as a spud.

A third step in the pruning of the raspberry is shortening the lateral branches which have developed from the headed-in shoot. This work is usually done in the spring before or at blooming time, and is

for the purpose of regulating the crop as well as reducing the wood so as to enable the cane more easily to support the fruit and to make the work of harvesting more easy.

From what has been stated it will have been inferred that the raspberry bears its fruit most abundantly upon wood one year of age, and that older wood is of little or no use and should be cut out for the good of the plant. There are exceptions to the rule, for raspberries frequently bear a few fruits upon the new shoots which annually come up from the root of the plant when those shoots are allowed to grow unchecked; but as this forms a late or second crop, and as it does not occur as a fixed habit of the plant, but rather as a result of peculiar weather conditions, it is never taken into account in commercial raspberry culture.

The shortening of the shoots to two feet or less in height, together with the thickening which follows, renders them able to support a crop of fruit without the aid of a trellis.

Varieties of Raspberries

Card in "Bush Fruits" gives the following classification of raspberries:

1. Black raspberries.
2. Purple-cane raspberries.
3. American-type red raspberries.
4. European-type red raspberries.
5. Unclassified varieties.

Varieties recommended by the American Pomological Society: (Only very successful varieties are given.—Ed.)

(See p. 1161 for map of districts.)

District No. 1. Vermont, Columbian, Shaffer, Gregg, Cuthbert, Golden.

District No. 2. Vermont, Columbian, Shaffer, Gregg.

District No. 3. Gregg, Cuthbert.

District No. 4. Shaffer, Hillborn, Kansas, Cuthbert.

District No. 5. Cuthbert.

District No. 6. None are recommended.

District No. 7. None are recommended.

District No. 8. Shaffer, Kansas.

District No. 9. Columbian, Shaffer, Eureka, Gregg, Kansas, Nemeha, Ohio, Older, Palmer, Cuthbert.

District No. 10. Gregg, Kansas, Cuthbert.

District No. 11. This district includes part of Texas and New Mexico. Not adapted to raspberries.

District No. 12. Gregg, Kansas, Cuthbert, Marlboro.

District No. 13. This district includes the western parts of North and South Dakota, Wyoming and Montana. This region is considered to be too cold for raspberries, yet there are doubtless sections of these countries where a few could be grown for home use.

District No. 14. Gregg, Kansas, Brandywine.

District No. 15. Red Antwerp, Gregg, Cuthbert, Miller.

District No. 16. Cuthbert, Hansel.

District No. 17. Cuthbert.

Prof. C. I. Lewis, of the Experiment Station, Corvallis, Oregon, recommends for that state the following:

The Marlboro is a berry that is increasing in popularity, and is often planted with the Cuthbert. It ripens and is out of the way before the Cuthbert is ready. The Cuthbert is practically our standard market variety. The Red Antwerp is a good bearer, but should not be left on the vines too long, else it becomes hard to remove. The Superlative, of comparatively recent origin, was expected by some growers to revolutionize the industry. It is a heavy bearer of fair quality, but is a poor shipper, and soon after gathering takes on a dull or dead color, thus losing its attractiveness.

Prof. W. S. Thornber, formerly of the Experiment Station, Pullman, Washington, recommends the following for Washington:

Black Raspberries

Gregg

One of the best and most popular black sorts. Valuable for home as well as commercial growing.

Kansas

An old, well-known variety, but not adapted to our conditions. Valuable only as an early sort.

Burkhart

A comparatively new, unknown sort which promises to become very valuable for both home and commercial growing.

Ohio

An old, well-known sort, especially valuable for canning and evaporating purposes. While strong and vigorous, it is not generally productive in this state.

The following varieties have been thoroughly tested in the Station gardens and found worthy or unworthy as indicated in these brief notes:

Red Raspberries: 7, Louden Fruit medium in size and earliness, light red, rather long, of fair quality (a popular variety in some localities but inferior to the Cuthbert as grown here). 9, Eaton Fruit dark red, resembling the Antwerp but has larger drupels; inclined to crumble; flavor fairly good; season medium. 10, Fill basket Largest berry in the list; comes in fruit early and stays late; very prolific, but soft and of poor quality. 12, Superlative—Fruit large, long, coarse, soft, of poor flavor. (Not to be recommended.)

Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station.

Red Raspberries: 13, Turner—Resembles the Cuthbert in almost every characteristic. 14, U. S. 49549—Almost identical with the Cuthbert. 15, Brandywine—Light red, medium size, of good quality; season about the same as Cuthbert. 16, Cuthbert—The most popular red raspberry grown; shape long, dark red, drupels small, firm, quality excellent; season late.

—*Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station*

Red Raspberries

Cuthbert

One of the oldest and most reliable strong-growing, midseason varieties, producing large crops of firm, medium-sized good shipping berries of fair quality. Its deep-rooting habit makes it possible for it to withstand severe drouth as well as cold winters.

Crimson Beauty

A strong, erect grower, producing large crops of medium-sized, rather soft berries. Good for home use but too soft for shipping.

Improved Superlative

A very popular, strong-growing variety with deep-rooting habits, producing large crops of firm, dark, crimson berries. Good for shipping as well as for home use.

Marlboro

An old, well-known variety, adapted to Western Washington conditions, but too much subject to sunburn for Eastern Washington conditions. A strong grower, heavy yielder and a good shipper of, good quality.

Philadelphia

A good early-season variety that can be used for home use, but the fruit is too small and soft to be of value for commercial purposes.

Red Antwerp

A well-known standard commercial sort, producing large crops of dark red, fine quality, good shipping berries. Valuable for Western Washington, but rather tender for Eastern Washington.

Turner

A good early home-use berry, but too soft for commercial use. The plants are strong, productive and free from insect pests.

It should be kept in mind that the conditions on the east and west of the Cascade range are very different. On the west side there is rainfall enough to grow fruits without irrigation and the air is full of moisture. On the east side the sun is hot and there is nothing grown for commercial purposes without irrigation, except in the wheat belt, where but few fruits of any kind are grown.

COST OF STARTING AN ACRE OF RED RASPBERRIES

Many people hesitate about setting out red raspberries because of the ungrounded supposition that no return may be expected the first season. During the past year I have kept a fairly accurate account of the receipts and the expenses of the first year of one acre of raspberries.

The acre on which the account was kept was practically new land the preceding year; that is, it had not been plowed for 75 years at least, and perhaps never had been. This made the expenses much greater than they ordinarily would have been, because of roughness and stoniness of the land, and also because it was thought advisable to sow a crop of rye for humus.

In the summer of 1912 the land was plowed and fitted and sowed to rye at a cost of $16. This last spring, 1913, the rye was turned under, the ground was fitted and set to red raspberries. The rows were six feet apart and the plants three feet apart in the row.

Instead of letting the land between the plants lie idle on most of the acre I set a cabbage plant between each two berry plants and a full row of cabbage between each two rows of berries. There were about twenty-four hundred berry plants an acre, and about seven thousand spaces for cabbage plants set as fillers. However, only about five thousand cabbages were set, the remainder of the acre being used for turnips. Cultivation was kept up during the summer, but the cabbages were hoed once and the turnips not at all. The expense and receipts account is given below:

Cost of putting in rye for a humus crop	$16.00
Plowing under same	3.00
Harrowing	2.00
Marking	.50
250 lbs. of a 2-6-8 fertilizer, broadcast	4.75
Cost of sowing fertilizer	.25
2,400 plants at $8 per M	19.20
Cost of setting plants	2.00
Cultivation five times, at 60 cents	3.00
Hoeing three times	3.00
Spraying for tent caterpillar	.50
Total expense of berries alone	$53.72

Additional cost of filler crops:

Cabbage and turnip seed	$ 1.00
Setting plants	7.00
300 lbs. of 2-6-8 fertilizer in the row	5.25
Hoeing cabbage once	1.50
Sowing fertilizer	.30
Paris green-bran-molasses mash for cutworm	1.00
Applying poison mash	1.00
Harvesting turnips and cabbage	19.70
Total additional expense	$36.75
Plus cost of berries alone	53.72
Total expense of berries and filler	$90.47

Receipts were:

140 bu. turnips at 25c	$ 35.00
10 tons of cabbage at $14	140.00
800 lbs. of cabbage at 50c per 100 lbs.	4.00
Total receipts	$179.00
Less total expense	90.47
Profit from one acre	$ 88.53

Thus it can be seen from an actual account that the first year of an acre of red raspberries yielded an income almost double the expense. I will say, however, that the cabbage crop was much better than the average, and the price was somewhat higher than usual, being about $14 a ton at the field, or $20 delivered New York or Boston. I think, however, that, year in and year out, this system

of intercropping will easily pay the entire cost of starting a raspberry field.

GEO. D. AIKEN,

Vermont Fruit Grower and Farmer, March 1, 1914.

RASPBERRIES FOR ALASKA. See *Alaska*.

Red Raspberries: 17, Carolina Golden—A yellow berry resembling the Cuthbert in size, shape and season; quality excellent but fruit soft; good for home use but not as a distant shipper. (Thought to be a sport of the Cuthbert.) 18, Golden Queen—Almost identical with the Carolina Golden.

—*Photo and Descriptions by J. H. Stahl, Western Washington Experiment Station.*

DISEASES

Anthracnose of Raspberry, Blackberry, Loganberry, Etc.

Gloeosporium venetum

H. S. JACKSON

The disease known as anthracnose is a very common trouble of certain varieties of blackberries and raspberries throughout the United States; and in Oregon, at least, the disease is becoming serious upon the loganberry as well. This is apparently an American disease, first described by Burrill in Illinois about 1882, and has often been referred to as causing considerable loss in various sections of the country. It is probably the most serious disease with which the loganberry grower is likely to have to deal, and in most sections spraying for this disease will doubtless become a regular operation in connection with the culture of this fruit.

The disease attacks the canes, leaves and the fruit. On the stems the disease produces spots of varying size and color, depending upon the variety attacked. The spots are pale in the center with irregular brown and black (or on the raspberry,

Fig. 1. Anthracnose Spots on Loganberry Canes.

particularly, purple) margins. Fig. 1 shows the characteristic appearance on canes of loganberry. The spots may run together, forming long, irregular patches of diseased tissue. On the leaves small spots are produced with pale centers, but with rather broad reddish or purple borders. (Fig. 2.) On some varieties the diseased area may drop out and give more or less of a shot-hole effect. On the fruits the drupelets are found to be affected, the fungus spotting the individual drupelets. These may be attacked when about half ripe or later. The disease on the fruit has been reported as particularly serious on the Snyder blackberry and on the loganberry.

Cause

This disease is due to a fungus, *Gloeosporium venetum*, which, growing in the tissues of the plant, produces the spotting described above. The fungus is reproduced in the spots by the formation of many minute spores. These spores are disseminated most abundantly by wind and rain. Under favorable conditions spores are produced in great numbers and the disease may spread rapidly over the field. No winter stage has been recorded for this fungus, and it is probable that the summer spore stage may live over on the dead leaves or canes, or in the spots on the living canes.

Prevention

Experience has shown that proper precautions in regard to sanitation have a very important bearing upon the control of this disease. All fruiting canes should be removed as early as practicable after the fruit is picked. These should be removed from the field and burned, preferably before all leaves fall. In trimming out the patch in the fall one should also prune out any seriously affected canes of the current year's growth. The removal of the canes of the current year's growth might be delayed till early spring on account of the danger of winter injury, but if this is practiced then they should be protected, as suggested below, by a fall application of spray. There seems to be considerable difference in the susceptibility of varieties to this disease, and where possible resistant varieties should be grown. The experience of investigators regarding spraying for this disease has not been uniformly successful; but it seems probable from experiments conducted by Lawrence that three sprayings in the spring will go far towards controlling this disease in the Northwest. Bordeaux mixture should be used in the 4-4-50 or 5-5-50 formula.

Spray first before the leaves appear in the spring, covering the canes thoroughly; spray again as soon as the leaves are well out and the young shoots are about six inches in height; spray a third time just before the plant blossoms. Where loss due to infection in the fruit is experienced, it may be found desirable to spray when the fruit is half to three-fourths grown. In this case the use of some spray mixture such as the Ammoniacal Copper Carbonate or Bergundy mixture may be found desirable, since such sprays leave no deposit on the fruit. Where the disease is particularly serious and spring spraying has not been entirely successful an application of Bordeaux mixture about the middle of August or first of September, before the fall rains begin, might prove advisable, because it would doubtless prevent a large

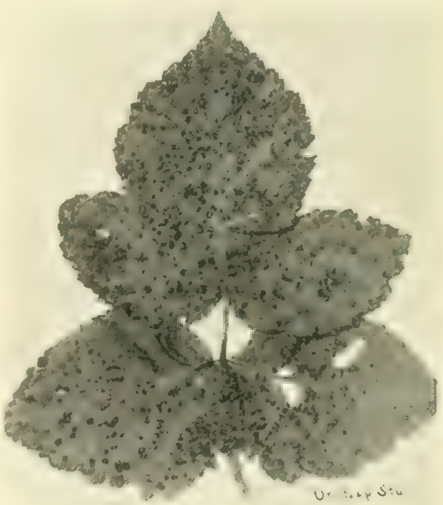


Fig. 2. Loganberry Leaf Showing Spots Caused by Anthracnose.

part of infection which occurs upon the canes and leaves in the fall. Since very little experimentation for the control of this disease, particularly on the loganberry, has been carried on under Oregon conditions, the above remarks on spraying should be considered as suggestive rather than as definite recommendations. It is hoped that careful experiments may be carried out by the Department of Plant Pathology at an early date.

Crown Gall

The disease known as crown gall or root knot is a common one on a large number of trees and small fruits as well as upon many herbaceous plants.

On the cane fruits crown gall is known particularly as a serious disease of the loganberry, blackberry and raspberry. See under *Apple.*

Mushroom Root Rot

The trouble known as mushroom root rot, which has attracted so much attention as a disease of apples and prunes in some sections of the Northwest, is known also as a disease of cane fruits. This disease has been reported as a serious trouble on cane fruits only in the Northwest. See under *Apple Diseases.*

Raspberry Cane Blight

Coniothyrium fukelii

P. J. O'Gara

In 1910 the attention of the writer was called to what appeared to be a new disease to those engaged in growing blackberries, raspberries, loganberries and other related varieties in the Rogue River country. The disease has shown marked virulence in some places and with some varieties.

Causes of the Disease

The disease has been named raspberry cane blight, although it attacks blackberries, loganberries, and other related varieties of the blackberry family. It is caused by a fungus *(Coniothyrium fukelii)*, which produces minute spores in enormous numbers.

These spores when blown about by the wind, or carried in any other way to the raspberry canes, are capable of germination when the proper temperature and moisture is present. Once the spores germinate and send their little root-like threads into the canes, destruction of the canes begins. After the fungus has vegetated within the canes for some time, it is found that the canes begin to wilt, and dead areas from which new spores come may be seen. When the spores are being expelled the dying canes often have a smutty appearance on account of the presence of countless numbers of these minute globular bodies. A close inspection of the diseased cane shows that the diseased patches on it are covered with minute pimples or pustules.

Varieties Diseased

Observations in the field show the following varieties to be affected: Gregg, Mammouth Cluster, Cumberland, Cuthbert. Amongst dewberries, Lucretia and Primus. The loganberry. Amongst blackberries, Mercereau and Blowers. The Gregg seems to be most susceptible, while the Golden Queen, a yellow variety, and the Phenomenal are least affected.

Fig. 1. Raspberry Cane Blight. Badly diseased blackcap (Gregg Variety). Note the small size of leaves and berries, and wilted condition.

Appearance of the Diseased Canes

Although the cane blight fungus is found to attack the fruiting canes most seriously, it also attacks young canes during the first season's growth and destroys them. In either case the whole cane may be involved, and generally in very susceptible varieties, such as blackcaps, the canes wilt and die down to the crown. To the casual observer, the leaves first begin to show a sickly yellow color, later becoming wilted and brown. In blackcaps the first, or early ripening berries, may be gathered, but as a rule the canes wilt so quickly in a severe case of the blight that the crop becomes a total loss.

Conditions Necessary for Infection

Owing to the fact that the blackberry and its related species are grown in rich soil where irrigation is practiced, the conditions for continuous infection during the summer season are always present. At this time ripe spores capable of immediate germination are being produced in countless numbers, and some of the canes have a smutty appearance due to the large number of spores which have exuded from the pustules found on the diseased canes. These spores may be transferred in many ways to healthy canes. It may be seen, therefore, that this season's young canes which are to be left for next year's crop may be diseased before the dormant season begins. There is no doubt that infection may also take place during the dormant season, that is, after the leaves have fallen from the canes. Owing to the mild winter weather in Rogue River valley there is no doubt that the fungus may continue its activity during the winter.

Control Measures

It has been stated that the only practical method of preventing the disease is to obtain healthy plants at the outset, and to avoid planting where raspberries or other related species have been grown. It is also advised to remove and burn old canes as promptly as possible before the leaves fall. Where the disease has become very serious all the canes should be cut close to the crown, and the ground carefully cleaned of all rubbish, which should be burned. The soil may then be drawn away from the crowns, which should be sprayed with a 5-5-50 Bordeaux before the winter rains begin. Where the disease has not become serious all old canes, and particularly the diseased

Fig. 2. Raspberry Cane Blight. Badly diseased cane of Gregg blackcap. Note the small pustules caused by the fungus at *a* and *b*. These pustules contain the spores of the fungus.

ones, should be cut off close to the crown and the remaining canes sprayed very thoroughly with Bordeaux. In spraying, it should not be considered wasting material to spray the ground about the crowns.

Spring and Summer Spraying

A thorough application of Bordeaux mixture should be given the canes in the spring before the leaves appear. This is done in order to kill any spores which might have escaped destruction by spraying in the fall. When the leaves are well out and the young shoots are six inches in height a second application of 5-5-50 Bordeaux should be made. A third appli-

cation should be made just before the canes begin to blossom. If thorough work is done the disease should be controlled.

For formula and directions for making, see under *Sprays*.

PESTS

FLAT-HEADED APPLE-TREE BORER. See *Apple Pests*.

Leaf Hoppers

Jassidae

A. L. LOVETT

The leaf hoppers are very small insects belonging to the order Hemiptera, or true bugs. They have the characteristic piercing or sucking mouth parts of this order, and have, in the adult state, wings with which they fly quickly when approached. Where they occur in numbers their presence is usually noted because of their habit of rising in small, quickly disappearing clouds ahead of one as he walks through the field.

Nature and Extent of Injuries

The injury to loganberries and blackberries due to leaf hoppers is seldom noticed unless severe. Often the injury they cause is charged to other agencies, such as fungus, drouth or frost, and their ranking as a pest is certainly underestimated. The foliage first appears speckled, white spots occurring on the upper surface of the leaves. Later the foliage becomes a sickly yellow with spots of white and dark green all over the surface. An examination of the under surface of the leaves at this time reveals the cast skins and a few adult forms. In addition to the injury to the foliage the hoppers often attack the developing flower buds. A bud or flower pierced by the leaf hoppers will not develop normally nor produce a perfect fruit.

Control Measures

Preventive

Clean up all leaves and trash in and about the field. Burn any grass in adjacent fence corners and fields where possible. Plow in the spring where practical.

Remedial

Remedial measures to prove most effective must be practiced in the early season on the nymphal forms. At this time the hoppers occur principally on the lower leaves, and by using an underspray nozzle and maintaining a fairly high pressure almost any of the contract sprays will control the pest. It must be borne in mind that the spray must actually wet the insect to prove effective. The adult insects and eggs are not usually killed by the spray and a second or even a third application may be necessary.

Among the contract sprays which are recommended are the following:

Whale-oil soap, 1 pound to 10 gallons of soft water.

Kerosene emulsion, if properly prepared, is possibly the best spray for the leaf hopper. It should be used as a 10-per cent solution.

Resin spray composed of 1 pound of resin and ¼ pound of lye dissolved in 15 gallons of water.

The tobacco sprays are also effective. "Black Leaf-40" at the rate of ½ pint of "Black Leaf-40" and 2 pounds of whale-oil soap to 50 gallons of water makes a very efficient contact spray.

For the adult leaf hoppers one might use sticky shields, something as recommended for the grape leaf hopper. These shields consist of heavy wires slightly curved and about 5 feet in length, the completed shield being about 4 feet wide. The wires are covered with oilcloth or canvas and the cloth smeared with crude oil or oil of resin. If two men each carrying one of these shields pass down opposite sides of the row at the same time, many of the hoppers will fly against the sticky surface and lodge.

Raspberry Horn-Tail

Hartigia cressoni (Family *Siricidae*)

Hartigia abdominalis

General Appearance

The adults are slender wasp-like insects, little more than one-half inch long and very active fliers. The females are yellow with dark markings, while in the males black predominates with very little yellow. The eggs are pearly white and oblong with a curved point at one end. The full-grown larvae are white with

dark head and tip and are nearly one inch long. They are almost the shape of a letter "S" and have a very noticeable point at the tail end. The pupae vary from the color and shape of the larvae to those of the adults.

Life History

The winter is passed within the canes of the host plants in the larval and pupal stages. The adults emerge in April, and after mating the females begin to insert their eggs into the tender tips of the young shoots. The eggs hatch in a short time into larvae, which work up the shoots until the latter are killed, when they turn and go down the middle pith of the stems and transform in the late fall and winter into pupae. There is but one brood each year.

Fig. 1. The Raspberry Horn Tail, *Hartigia cressoni*. a, adult female; b, adult male; c, well-developed pupa; d, very young pupa; e and f, larvae. (Essig, M. B. Cal. Hort. Com.)

Food Plants

The native host of this insect is probably the wild rose. Raspberries suffer most from the attacks. Cultivated roses, blackberries and loganberries are also food plants.

Control

Measures necessary to remove or destroy the eggs before the young larvae hatch should be inaugurated. As the eggs are very tender and their locations plain, great numbers may be quickly destroyed by exerting a slight pressure over them with the fingers, which in no way injures the shoot. Cutting out infested canes is also recommended.

E. O. Essig

Oyster-Shell Scale. See *Apple Pests*.

Raspberry Cane Maggot

Phorbia rubivora Coq.

A. L. Lovett

The new canes of the raspberry, loganberry, dewberry and blackberry are sometimes observed in the spring drooping in a characteristic manner. If the affected shoot is examined carefully, a bluish ring will be observed at the base of the wilted tip, and by cutting into the interior a small, whitish maggot is disclosed.

The adult of this maggot is a fly, similar in appearance to the house fly, though somewhat smaller in size. These flies appear in early April and are present through May and June. The females deposit eggs on the canes of their host. The egg is usually placed in the groove formed by the branching off of the leaf axil from the growing stem. The egg is white in color, elongated and of a fair size. The maggot which hatches from this egg crawls down the cane a short distance and bores its way through the surface of the stem and into the pith. The maggot feeds down the cane for a short distance, it then turns toward the surface or bores through the woody tissue to just beneath the surface of the bark. It now turns at right angles and girdles the cane. This girdle constitutes the bluish ring, from the effects of which the tip wilts and dies.

Remedial Measures

Cut off the infested canes well below the girdle and destroy.

Raspberry Root Borer or Blackberry Crown Borer

Bembecia marginata Harr.

A. L. Lovett

This insect has appeared in certain of the bush-fruit districts of the Northwest,

and while it is at present confined to a rather limited area, it will without doubt spread and eventually become a serious pest. The larva or borer of this insect tunnels into the canes, crowns and even the lateral roots of the blackberry and raspberry, eating out the pith and weakening the entire plant system. Only in severe cases do they kill the plant outright, their presence usually being first indicated by the wilting or death of an occasional cane or by the smaller size and inferior quality of the berries.

Life History and Habits

The adult of this borer is a rather attractive clear-winged moth, nearly three-quarters of an inch in length and bearing to the ordinary observer a close resemblance to a wasp. The head and thorax are brownish black. Around each eye is a yellow ring, the antennae are black. The abdomen is colored with alternating rings of yellow and black. These adult moths commence emerging from the pupa cases about the middle of July and individuals continue to appear until late September. These adult moths are very sluggish, move slowly and fly heavily. The female deposits eggs on the under side of the blackberry and raspberry leaves. These eggs are reddish brown, about 1-16 inch in length, and hatch in late September or October. The larvae burrow into the cane near the ground and hibernate. They become active in crowns and stems the following spring, hibernating a second winter, after which they pupate and emerge as adults, to begin a new cycle.

Not all of the injury these insects do is directly traceable to the feeding of the larvae on the roots. The exit holes afford a means for the ready entrance of water and the subsequent decay of the canes and roots.

Remedies

Numerous birds have been observed flying about in yards catching and feeding upon the adult moths. Therefore, protect the birds. On account of their sluggish habits of flight poultry could undoubtedly pick up many of the emerging adult moths. No spray is practical for the adult moths nor for the larvae after they have entered the cane or root. It would seem that some sticky substance applied to the canes in early fall might prevent the hatching larvae from crawling down the stalks to enter the root. So far as we know no such trials have been made, and until they are, we could not consistently advise any such treatment. The digging and burning of infested plants seems practical only when the infestation is sufficiently severe as to show an effect on the plant. Many of the larvae may be collected in the old canes and stump of canes during June and July, when they are forming the emergence tunnels for the escape of the adults.

ROSE SCALE. See *Blackberry Pests.*

SAN JOSE SCALE. See *Apple Pests.*

SNOWY TREE CRICKET. See *Blackberry Pests.*

STRAWBERRY CROWN MOTH. See *Strawberry Pests.*

Tree Crickets

Ecanthus sp.

One of the most common forms of injury to the canes of blackberry and raspberry is a series of punctures resembling a line of pin pricks, ranged longitudinally with the cane. By splitting the cane there will be found in each puncture an elongated, yellowish, slightly curved egg, about one-eighth of an inch long. The insects which lay these eggs are pale, whitish-green insects, with long, thread-like antennae and whitish or membranous wings, which, particularly in case of the males, lie flat on the back. With some species there are dusky stripes on the head and thorax and the legs and antennae are blackish. They are allied to the grasshoppers and crickets, and are commonly known as tree crickets. There are two common species, *Ecanthus nigricornis* and *Ecanthus quadripunctatus*, which oviposit in raspberry and blackberry canes, chiefly during the month of September. The young crickets, when first hatched in midsummer, feed to a limited extent upon plant lice, but in the fall upon ripe fruits

or other succulent food. There is no remedy except to prune out and burn the canes containing eggs. This may be done in late fall or early spring.

Recipes

The recipes in this department were arranged by Miss Alice M. Hodge, Supervisor of Domestic Science in the Public Schools, North Yakima, Wash.

Table of Weights and Measures

A teaspoon of regulation size holds 60 drops.

3 teaspoons liquid equal 1 tablespoon.

4 tablespoons liquid equal ½ gill or ¼ cup.

2 gills equal 1 cup.

2 cups equal 1 pint.

4 cups (2 pints) equal 1 quart.

4 cups flour equal 1 pound.

2 cups butter equal 1 pound.

½ cup butter equals ¼ pound.

2 cups granulated sugar equal 1 pound.

2 cups milk or water equal 1 pound.

2 cups chopped meat equal 1 pound.

9 or 10 eggs (without shells) equal 1 pound.

2 tablespoonfuls butter equal 1 ounce.

2 tablespoons sugar equal 1 ounce.

4 tablespoons liquid equal 1 wineglassful.

4 tablespoons flour equal 1 ounce.

APPLES

Always cook apples in earthen or granite ware utensils, and use silver, granite or wooden spoons for stirring.

Average Composition of the Apple

Water	82.5
Carbohydrates	12.5
Proteid	.4
Nitrogenous	.4
Fats	.5
Acids	1.0
Cellulose	2.7

From a dietetic standpoint the most important function of the apple is that of furnishing mineral salts and organic acids, but it has an important nutritive value as well, furnished by the carbohydrates present. As the fruit ripens the starch changes to sugar.

The apple has a medicinal value as well, especially if eaten at the beginning of the meal or between meals.

Varieties Good for Sauce and Baking

Alexander	Peck
Baldwin	Red Astrachan
Duchess of Oldenberg	Rome Beauty
Gravenstein	Rhode Island Greening
Grimes Golden	Rainbow
Golden Russet	Siegrende Renette
Gano	Shiawasse Beauty
Hubbardston	Spitzenburg
Jonathan	Twenty Ounce Pippin
Jefferis	Wallbridge
King	Wealthy
Lawver	Wagener
Lead	Wolf River
Maiden Blush	White Pearmain
McMahan's White	York Imperial
Ortley or Yellow Bellflower	Yellow Transparent

Good Cider Apples

Baldwin	Imperial Rambo
Buckingham	Jefferis
Dyer Sweet	Maiden Blush
English Russet	Newtown Pippin
Gravenstein	Seek-No-Further
Golden Sweet	Wolf River

Afterthought

One pint of nice apple sauce, sweetened to taste; stir in the yolks of 2 eggs well beaten. Bake for 15 minutes. Cover with a meringue made of 2 well-beaten whites and ½ cup of powdered sugar. Return to the oven and brown.

Apples With Almond Praulinee, Jelly and Cream

Core and pare 10 apples, cook in a syrup made of a cup of water and a cup of sugar, turn the apples and cook until fork will pierce them in the hollow center. Set the cooked apples on a serving dish. Blanch and chop fine ¼ of a cup of almonds. Cook ¾ of a cup of sugar to a caramel; when the sugar begins to turn a light brown add the nuts and stir constantly until the sugar is cooked enough. Put a spoonful of the caramel on the top of each apple, around the

central opening; put a teaspoon of currant jelly in the center of each apple. Beat a cup of cream until firm; put this around the apples and serve.

Apricot Sherbet Served in Apple Shells

Select bright red apples of uniform size, rub until they have a high polish. Cut off the blossom end and scoop out the pulp; carefully notch the edge. Fill with apricot sherbet and serve upon apple leaves.

Apple Balls With a Mixture of Fruit

Peel large apples; with a potato scoop cut out small balls, dropping them into water with a little vinegar added to keep them white. Prepare a mixture of grapefruit pulp, pineapple and banana, and put into glasses; add a few of the apple balls; pour over all the juice left from the fruit, which has been boiled down with sugar; cool and serve at once or the apples may turn brown.

Baked Apples With Nuts

Peel and core as many apples as are desired and place them in a deep pan, with a heaping tablespoonful of sugar and half a cupful of water to each apple. Place in the center of each apple a spoonful of chopped nuts and a strip of lemon or orange peel. Sprinkle with cinnamon and nutmeg, and bake very slowly until the juice becomes jelly-like.

Apples in Bloom

Cook red apples in boiling water until soft. Have the water half surround the apples and turn often. Remove skins carefully that the red color may remain, and arrange on serving dish. To the water add 1 cup of sugar, grated rind of 1 lemon and juice of 1 orange; simmer until reduced to 1 cup. Cool and pour over the apples. Serve with cream sauce.

Cream Sauce

Beat the white of 1 egg stiff; add the well-beaten yolk of 1 egg, and gradually add 1 cup of powdered sugar. Beat ½ cup of thick cream and ¼ cup of milk until stiff; combine the mixture and add ½ teaspoon of vanilla.

Brown Betty

Pare and chop six apples. Place a layer of apple in a well-buttered pudding dish, then a layer of bread crumbs; sprinkle with brown sugar and cinnamon; repeat until the dish is full; add several generous lumps of butter and pour sweet milk or hot water on until it comes within an inch of the top of the pan. Bake in a moderate oven until brown, and serve with plain or whipped cream.

Apple Butter Canapes

Cut thick slices from a loaf of brown bread. Stamp into rounds with a biscuit cutter. Spread each round with apple butter. In the center place an English walnut or hickory nut meat, and arrange a border of chopped nuts around the edge. Serve with cheese cubes.

Apple Butter

Pare, core and quarter the desired quantity of apples, allowing one-third of sweet to two-thirds of sour apples. Boil sweet cider until it is reduced one-half. While the cider is boiling rapidly add apples until the mixture is the desired thickness. Cook slowly, stirring constantly, and skimming when necessary. When the apples begin to separate from the cider, take 2 pounds of sugar to each bushel of apples used; add a little ground cinnamon, and boil until it remains in a smooth mass, when a little is cooled. Usually 1½ bushels of apples are enough for 1½ gallons of boiled cider.

Apple Biscuit

To 1 pint of light bread sponge add ¼ cup of molasses, 1 tablespoon of lard and graham or whole wheat for a soft dough. Beat vigorously and finally work into the dough 1 large cup of chopped apple; shape the dough into biscuit and place in muffin pans, and allow them to be very light before baking.

Apples en Casserole

Pare, core and slice 2 quarts of apples and put in an earthen dish, alternately, with 1½ cups of sugar; add ¼ cup of cold water, cover the dish and bake in a moderate oven. Serve either hot or cold, with cream.

Apple Catchup

Quarter, pare and core 12 sour apples. Put in a sauce pan, cover with water and let simmer until soft; nearly all of the water should be evaporated; rub through a sieve, and add the following to each quart of pulp: 1 cup of sugar, 1 teaspoon of cloves, 1 teaspoon of mustard, 2 teaspoons of cinnamon and 1 tablespoon of salt, 2 cups of vinegar and 2 grated onions. Bring the catchup to a boil and let simmer gently for 1 hour. Bottle, cork and seal.

Apple Charlotte

Pare, core and slice apples; cook in butter until soft and dry; add sugar to taste. Line a plain mould with sippets of bread an inch wide, dipped in melted butter; let one overlap the other; arrange lozenges of bread similarly in the bottom of the mould. Fill the center with the apple and cover the top with bread. Bake for half an hour in a hot oven. Serve with cream and sugar or a hot sauce.

Clarified Apples

Make a syrup of 2 cups of sugar and 1 cup of water. Pare, core and cut into sixths 6 large, tart apples. Cook a few at a time in the syrup until clear, remove and drain; add the rind and juice of ½ lemon to the syrup, boil until thick; remove the lemon rind, and pour over the apples.

Clove Apples for Cold Meats

Take 3¼ pounds sugar, 2 cupfuls of water and boil to a syrup. Drop in quarter of apples, pared, and when they are cooked lift out carefully with a fork. When all the fruit has been cooked drop some of the skins in the syrup with 1 dozen cloves. Cook about 20 minutes, remove the skins, but pour the syrup with the cloves over the apples in a jar and cover up. This is inexpensive and beats all kinds of chutney.

Apple Cobbler

Pare and quarter enough tart apples to fill a baking dish three-fourths full. Cover with a rich baking powder biscuit dough made soft enough to stir; spread it over the apples without rolling. Make several cuts in the center to allow the steam to escape. Bake for three-quarters of an hour, and serve hot with sugar and rich cream.

Coddled Apples

Take tart, ripe apples of uniform size, remove the cores. Place the fruit in the bottom of a porcelain kettle; spread thickly with sugar; cover the bottom of the kettle with water and allow the apples to simmer until tender. Pour the syrup over the apples and serve cold.

Apple Conserve

For each pound of quartered and pared apples allow ¾ of a pound of sugar and half a pint of water. Boil sugar and water until a rich syrup is formed; add the apples and simmer until clear. Take up carefully, lay on plates and dry in the sun. Roll in sugar, and pack in tin boxes lined with waxed paper.

Compote of Apples

One pound of apples, ¼ pound of lump sugar, 1 cup of water, the juice of half a lemon, a few drops of red coloring. Put the sugar, water and lemon juice into a clean enameled sauce pan and let them boil quickly for 10 minutes. Meanwhile, peel the apples, cut them in quarters and remove the cores. Throw the pieces into the boiling syrup and let them cook slowly until clear and tender, but not broken. Then remove the quarters of apple carefully, reduce the syrup a little and color it pink with the red coloring. Arrange the apples on a glass dish and pour the syrup over. A little cream of custard served with the compote is a great improvement. If the apples are small, they may be cored and cooked whole.

Apple Compote and Orange Marmalade

Boil 12 tart apples in 1 quart of water until tender; strain through a jelly bag; add 1 pound of granulated sugar, and let boil. While boiling add 12 apples, cored and pared. When the apples are tender, drain them carefully in a perforated skimmer. Boil the syrup until it jells; fill the apples with orange marmalade

and pour the syrup over them. Serve with whipped cream.

Crabapple Marmalade

Wash and core crabapples and put them through the meat chopper. Put into a preserving kettle and add water until it shows through the top layer of apples. Cook until soft. Weigh and add an equal weight of sugar. Cook until the mixture forms a jelly when cooled, and pour into sterilized glasses. Cover with paraffin.

Apple Custards

Steam two large, tart apples that have been peeled and cored. Rub them through a sieve, and add 1 cupful of milk, 2 teaspoonfuls of butter, ¼ of a cupful of sugar and the yolks of 4 eggs. Turn the mixture into baking cups, stand them in hot water and bake about 20 minutes. When they come from the oven, pile the beaten white of egg on top of each cup, sprinkle with powdered sugar and place in the oven to brown slightly. Serve cold.

Apple Croquettes

Pare, quarter and core enough tart apples to make a pint; place in a saucepan with 1 small tablespoon of butter and, if the apples are not juicy, a few tablespoons of water. Cover and stew gently until tender, then press through a sieve. Return to the fire and add sugar. Add 1 tablespoon of cornstarch and ¼ of a teaspoon of salt, mixed to a thin paste with cold water; stir until thickened, cover and cook slowly for 15 minutes. Turn out on a greased dish and set away until cold. Form into tiny croquettes, roll in bread crumbs, dip in lightly beaten egg, then roll again in crumbs and fry in deep fat; drain on unglazed paper and serve with roast pork or roast goose.

Delmonico Apples

Put a layer of apple sauce in a buttered pudding dish, sprinkle with ground almonds, dot with butter and sprinkle with crushed macaroons, add a little water and bake. Delicious when served with meat.

Apple Delight

Put a layer of apple sauce in a buttered pudding dish, dot with butter, add a layer of chopped peaches and apricots, sprinkle with blanched almonds ground rather coarsely, repeat until the pan is full; pour the peach juice over the mixture and bake for one hour. Serve as a relish with meat course.

East India Chutney (Apple)

Pare and core 12 sour apples. Peel 1 medium-sized onion. Remove seeds and stems from 3 peppers, 1 of which should be red. Chop apples, peppers, onion and 1 cup of raisins very fine. Add the juice of 4 lemons, 1 pint of cider vinegar and half a cup of currant jelly; let simmer very gently for one hour, stirring frequently. Add 1 pint of cider vinegar, 2 cups of sugar, 1 tablespoon each of salt and ground ginger and ¼ of a teaspoonful of cayenne; cook for one hour more, stirring constantly. Store as canned fruit.

Apple Farci

Choose tart red apples, Northern Spys, if possible; wash, wipe and core. Do not pare. With the corer remove apple in three places, equally distant from stem and blossom end, holding corer in oblique position and pressing downward toward center. Fill these cavities with raisins, dates or figs, sugar, cinnamon. Canned or fresh pineapple is delicious filling. Always use raisins, placing them in the cavities first to prevent the other filling from slipping through. After filling, place the apples in a pan that has been sprinkled with sugar and cinnamon. Sprinkle each apple with sugar and cinnamon. Place in a hot oven until the sugar melts, then add ¼ cup of water or fruit juice, and bake until tender. Baste frequently with the syrup. Serve either hot or cold, with whipped cream sprinkled with cocoa.

Apple Float

Peel six big apples and slice them. Put them in a sauce pan with just enough water to cover them, and cook until tender. Then put them through a colander

and add the grated rind and juice of half a lemon, sweeten to taste and stir in a trace of nutmeg. Fold in the stifly beaten whites of four eggs, and put the dish on ice. Serve with whipped or plain cream.

Apples Fried With Onions

Peel onions and slice. Fry in fat until a rich grown; drain on soft brown paper. Fry unpared quarters of apple in the fat left from the onions. Arrange apples in a border on a platter; fill center with the fried onions, and serve hot.

Fried Apples

Quarter and core five apples without paring. Put into a frying pan one cup of sugar, one tablespoon of butter and three tablespoons of water. Let this melt and lay in the apples with the skin up. Cover and fry slowly until brown.

Apple Fritters

One cup of sweet milk, one egg, one teaspoon of baking powder, one-fourth teaspoon of salt, one half cup of chopped apples; flour to make a batter stiff enough to drop heavily from the spoon. Fry in deep fat.

Frosted Apples

Pare and core ten large apples. Cover with one pint of water and three tablespoons of sugar; simmer until tender. Remove from the syrup and drain. Wash the parings and let simmer with a little water for one-half an hour. Beat the white of one egg to stiff froth and add one tablespoon of sugar. Coat the top of the apples lightly with the meringue and place in a cool oven to dry. Strain the juice from the parings, add two tablespoons of sugar, return to the fire and let boil for five minutes; add a few drops of lemon and a little nutmeg, cool and pour around the apples.

Apple Gelatin

Cover one-half box of gelatin with half a cup of cold water and let stand for half an hour. Pare, core and quarter 6 tart apples, add the thin, yellow rind of half a lemon, cover with sweet cider, or water, boil and press through a sieve; add one cup of sugar and juice of one lemon. Pour over the gelatin, mix, turn into a mold and let harden. Serve with cream or cider sauce.

Ginger Apples

Pare and core some good apples, Greenings or Pippins. Fill the cavity in the center of each apple with a spoonful of chopped preserved ginger. Stand them in your baking dish (not tin) and pour over them a syrup made either of sugar and water flavored with lemon, and with a piece of dried ginger cooked in it, or if there is enough ginger syrup, this may be used with the addition of a little water. Bake until soft and transparent, but not broken, basting occasionally with the syrup. Serve hot or cold, with a little whipped cream garnished with some pieces of ginger.

Garnish for Roast Goose

Cook rings of apples clear in syrup. Drain, place a stewed prune in the center of each and sprinkle with chopped pistachio nuts. Arrange around the platter and place the goose in the center.

German Apple Cup

Core fine-grained apples, pare except one ring around the center. Cut celery hearts fine; mix with mayonnaise dressing, to which a little salt, pepper and half the bulk of whipped cream has been added. Fill the cavities of the apples and round up a little. Set on heart-shaped lettuce leaves. If the apples must stand after being pared, rub lightly with a cut lemon to prevent discoloration.

Apple Goodie

Cut apples in balls with a vegetable scoop and cook until tender in a little syrup, to which a little lemon juice has been added. Toast slices of bread or stale cake; dip in milk, to which a little salt and butter have been added. Pile apple balls on slices of bread or cake, with five or six blanched almonds; add bits of any kind of jelly or marmalade. Serve with plain cream.

Glazed Apples With Spiced Prunes

Choose large apples of uniform size; pare, core and cook until tender in syrup. Remove to a platter. Boil the syrup down to a jelly and pour over the apples.

Fill the centers with spiced prunes and dust the top of each apple with powdered sugar and serve hot.

Hodgepodge Pudding

2 cupfuls of apples, chopped fine.
1 cupful of chopped English walnuts.
½ cupful of raisins, seeded and chopped.
¼ cupful of orange juice.
½ teaspoonful of ground cinnamon.
3 tablespoonfuls of sugar.

Mix the ingredients, turn into a buttered baking-dish, dot the top with bits of butter, and bake (covered) until the apples are tender. Moisten with a little water if the apples are not sufficiently juicy. Serve hot with a sauce made as follows: Cream half a cupful of butter, add gradually 1 cupful of brown sugar, heat in a double boiler, adding gradually and very slowly half a cupful of cream. Stir constantly to prevent curdling. Add 1 teaspoonful of vanilla extract after removing the sauce from the fire.

Apple Icing

One cup of sugar, one-third cup of water, 1 saltspoon of cream of tartar; heat gradually and boil without stirring until the syrup will thread when dropped from a fork. Pour slowly over the well-beaten white of one egg, beating constantly, and continue until thick enough to spread. Add 2 tablespoons of grated apple, beat and spread on the cake.

Apple Jonathan

Peel and slice very thin four large or five small Greening apples; place in deep pudding dish or baking dish with 2 tablespoonfuls cold water. Make batter of one-third cupful of butter, 1 large cupful of granulated sugar, 2 eggs beaten thoroughly, 2 large cupfuls flour, with 4 teaspoonfuls good baking powder and 1 teaspoonful salt sifted together, stirring well; then add flour. Blend the whole for five minutes, then pour over the apples; let stand five minutes before placing in oven; bake 30 minutes.

Sauce for Apple Jonathan

One and one-half cupfuls sweet milk, 1 tablespoonful butter, one-half cupful sugar, 2 tablespoonfuls constarch, 3 heaping tablespoonfuls raspberry jam. Place milk in porcelain dish over fire, let boil slowly; mix butter, sugar and cornstarch together; add one-third cupful cold milk; mix until smooth, then stir slowly into the boiling milk; let boil five minutes, then remove from fire and add raspberry jam. To be served hot.

Jellied Apples With Almonds

Pare, core and quarter Golden Pippins; stew until soft and beat smooth. Make syrup by boiling a pound and a half of sugar and a pint of water for every two pounds of apples. Put the apple pulp and the juice of 3 lemons into the syrup and boil gently until stiff enough to drop heavily from the spoon. Pour into a wet mold and when cold turn onto a serving dish. Stick blanched almonds into the jelly and surround with whipped cream.

Apples, Lexington Style

Core and pare eight apples, rub with lemon and cut in halves and cook in a syrup until tender. Let them cool, then roll in sponge cake crumbs, then in egg and milk, then in the crumbs, and cook in deep fat. Fill the centers with grated pineapple and currant jelly. Surround the apples with the syrup and serve.

Apple Loaf

Reserve enough bread dough to make a small loaf. Work thoroughly into it one tablespoon of butter, one-third cup of sugar, one-quarter of a teaspoon of cinnamon and 2 well-beaten eggs. Add flour to make a soft dough, knead lightly and let rise. Divide into three equal parts and roll each part to fit the pan. Lay one piece in a buttered pan, spread over it an inch layer of sour apples chopped fine. Pour over the apples a tablespoon of melted butter; cover with the second piece of dough and continue as before; brush the top with milk and let rise until very light. Steam for one hour, then place in a hot oven to brown lightly. Serve in slices with sugar and cream.

Apples in Maple Syrup

Cut eight apples in halves and remove the cores with a teaspoon; put into a bak-

ing pan with 1 cup of maple syrup and $1\frac{1}{2}$ cups of water and 2 tablespoons of butter. Bake until the syrup is thick and serve with whipped cream.

Apple Macedoine

Cut a thick slice off the stem end of red apples, core and remove the pulp with a potato-ball cutter. Cook one-half cup of sugar with 1 cup of water. Add clean rose geranium leaves and apple balls; cook until the balls are tender. When the syrup is cold, add the juice of 1 lemon and a couple of peaches sliced into small pieces. Fill the apple shells with the mixture and serve very cold as a first course at a luncheon.

Apple Marmalade

Pare, core and cut into small pieces coarse-grained apples. Allow a pound of sugar to each pound of apples. Add enough water to dissolve the sugar and boil until thick; add the apples and boil until tender; pass through colander; add the juice and grate rind of a lemon to every 4 pounds of fruit. Boil again until thick and put up in jars or glasses. Cover with paraffin.

Crabapple marmalade may be made in the same way with the lemon omitted. When cold it should cut like cream cheese.

Apple Meringue

Two cups of steamed apple pulp, one-half cup of sugar, 1 teaspoon of butter, one-half teaspoon of cinnamon or nutmeg. Add the yolks of 2 eggs, slightly beaten, and 1 tablespoon of thick cream. Fill a deep pie tin lined with crust and bake without an upper crust. Make a meringue of the whites of 2 eggs and 2 tablespoons of sugar; brown in a very moderate oven.

Apples With Nut Stuffing and Whipped Cream

Scoop out apples and fill the shell with English walnuts and apple pulp mixed with mayonnaise; place in a circle on a large serving dish and heap whipped cream in the center.

Apple Omelet

To eight large apples stewed very soft and mashed fine add 1 cup of sugar, and flavor with nutmeg or cinnamon. When cold stir in 3 well-beaten eggs and one-half tablespoon cornstarch dissolved in 2 tablespoons of milk. Stir well and bake slowly 20 minutes. Serve hot.

Oxford Apples

Pare, core and quarter 4 large, tart apples and boil in very little water. Mash and add 1 tablespoon of butter, half a cup of sugar, half a cup of fine bread crumbs, the yolks of 4 eggs and the whites of 2 eggs beaten light. Pour into a baking dish and cover with a meringue made of the whites of 2 eggs and two tablespoons of powdered sugar, and brown.

Apples With Oatmeal

Core apples, leaving large cavities, pare and cook in a syrup made by boiling 1 cup of sugar with $1\frac{1}{2}$ cups of water for five minutes. When the apples are soft, drain and fill cavities with the hot, well-cooked meal, and serve with cream and sugar.

Apples a la Parisienne

Pare several sour apples, cut them in half crosswise and remove the cores. Cook them with 1 cupful of sugar to 1 cupful of water, taking care to retain the shape. Drain the apples and set each half on a round of stale sponge cake, sprinkled lightly with orange juice and either orange or peach marmalade. Cover the apple with a meringue and some chopped almonds and set in the oven to brown delicately. Serve either hot or cold.

Apple Pone

Pare and chop fine 1 quart of sweet apples. Pour a pint of boiling water over 1 quart of white corn-meal; when cool, add enough sweet milk to make a very soft batter; add 2 tablespoons of sugar and one-half teaspoon of salt. Add the apples and pour into a well-buttered pan, cover and bake in a moderate oven for two hours.

Crabapple Pickles

Leave stems on, prick with a fork, steam until cooked through. Pour over the sweet syrup three days in succession,

third time returning to thoroughly heat through before putting into jars.

Porcupine Apples

Select apples of equal size. Pare, core and cook in syrup made of 1 cup of water to each half cup of sugar. Boil syrup down and roll the apples in it. Stud with blanched almonds; fill the centers with jelly. Arrange on a large plate with rolled wafers between apples.

Apple and Potato Gateau

5 apples.
1 cupful of sugar.
Juice and grated rind of half a lemon.
2 good-sized baked potatoes.
2 eggs.
1 wineglassful of sherry.
½ cupful of apple jelly.
½ cupful of unsweetened custard.

Core and peel the apples and put them in the double boiler with the sugar and lemon juice and rind. Remove the skins from the baked potatoes and rub the pulp through a sieve. Separate the yolks and whites of the eggs, beat them thoroughly and add them to the apple pulp when cool. Add the potato pulp, and the sherry—if it is to be used. Bake in a greased mold. When done pour the apple jelly and custard over the pudding. The dish may be attractively decorated with chopped pistachios and candied cherries.

Apple Punch

Cut six tart apples in quarters; core, but do not pare; put into a preserving kettle and add 1 cup of raisins; 2 bay leaves, a small piece of stick cinnamon, the grated rind of 3 lemons and 2 quarts of cold water; let come to a boil and add 2 quarts more of cold water, cover and let boil for 30 minutes; drain through a muslin bag. When cold add the juice of 3 lemons and 2 pounds of sugar; stir until the sugar is dissolved. When ready to serve, add a little shaved ice.

Raised Apple Biscuit

Scald 1 cup of milk, add 1 teaspoon of sugar and 1 tablespoon of butter, let cool. Add one-half cake of yeast dissolved in warm water, 1 teaspoon of salt and 1 cup of flour. Let rise; add cup of apple, pared and grated, and 1 cup of flour sifted with one-half teaspoon of soda. Let rise for one hour. Shape into two flat cakes, let them double their bulk, bake in hot oven; split while hot and butter. Serve hot with sugar and butter.

Apples and Rice

Pare and core apples, place in a baking dish and fill the holes in the apples with chopped raisins and sugar; fill the spaces between the apples with rice that has been boiled for 15 minutes. Cover and bake for 15 minutes, remove cover and bake for 15 minutes longer. Serve hot with cream.

Apple Relish

Three pounds of apples diced with the skins on. Take 3 pounds sugar, 1 pound raisins, 1 pound pecans, 2 oranges; remove peeling and grind it in meat grinder; then cut the orange into small pieces. Cook for one hour, adding the nuts five minutes before removing from the stove.

Apple Sandwich

Cut lady-finger cakes in halves and spread with apple sauce; press halves together and cover with whipped cream and walnuts chopped fine.

Apple Schmarren

Make a batter of 1 tablespoon of pastry flour, 2 tablespoons of milk, a pinch of salt and a well-beaten egg. Slice into this batter 1 good-sized apple. Put into a frying pan 1 teaspoon of clear lard, heat it and pour in the batter, fry a nice brown and serve with powdered sugar.

Apple Sherbet

Boil 1 quart of apples in a pint of water until soft. Mash through a sieve. Add the juice of 1 orange and 1 lemon, half a pound of sugar and a quart of water. Beat well and freeze. When it becomes like slush, add the well-beaten white of one egg and finish freezing.

Spiced Crabapples

Select sound Siberian or Transcendent crabs with the stems on. Boil 3 pounds sugar and 1½ pints of cider vinegar to a rich syrup, add 2 ounces of stick cinnamon. Drop a few of the crabapples into

the syrup, turn and cook until tender, remove and place in jars; continue until the apples are all used, boil the syrup down and pour over the fruit. If the crab-apples are very ripe it is better to steam them until tender. Place in jars and pour the syrup over them.

Sausages and Fried Apples

Prick the sausages well with a fork. Place in a deep frying pan; pour in enough boiling water to cover the bottom; cover and cook over a moderate fire. When the water evaporates, remove the cover and turn several times, that they may be nicely browned. Turn onto a platter. Core a number of large, tart apples, cut them in rings an inch thick and fry in the sausage fat. Garnish the sausage with the apples and serve.

Stuffed Apples to Serve With a Roast

Into a sauce pan put 2½ cups of white stock, add a bay leaf, 1 teaspoonful of minced onion, half a teaspoonful of salt and a very little pepper. Simmer for 20 minutes and strain. Pare and core ten tart apples, put them in a granite pan, pour the stock around, cover and simmer until tender, but not broken. Carefully remove from the stock and set aside. Blanch two cupfuls of chestnut meats, slice, cover with the stock, add four teaspoonfuls of currant jelly, half a saltspoonful of salt, a little paprika, and simmer until the nuts are tender. Fill the center of the apples heaping full, and garnish the roast meat with them.

Apples en Surprise

Make apple cups by cutting a thick slice from the stem end and removing the pulp with a teaspoon. Fill the cups with equal quantities of the apple pulp, pecan meats and maraschino cherries cut into small pieces. Add 1 teaspoon of sugar to each apple and bake until the apples are soft, but will hold their shape. Remove from the oven and add 1 teaspoon of maraschino and 1 teaspoon of sherry to each cup.

Apple Sponge

Cover one-half box of gelatin with cold water and allow it to stand for half an hour; then pour over it half a pint of boiling water and stir until dissolved. Mix a pint of strained apple sauce with the gelatin, add a pound of sugar and stir until it melts, and the juice of 2 lemons. Set on ice until it begins to thicken. Beat the whites of 3 eggs to a stiff froth, stir into the apple mixture and pour into a mold. Serve with whipped cream.

Apples Stuffed With Figs

Pare and core large apples; fill centers with chopped figs, cover with sugar, place in a deep baking dish and add a little water; bake, basting well frequently. Serve cold with cream.

Sweet Cider Frappe

Pack the can of a freezer with one measure of salt mixed with three measures of crushed ice. When the can is frosted, pour in sweet cider and freeze like sherbet. Serve with roast turkey or immediately after it.

Apple Souffle

Pare, core and cook 4 tart apples in just enough water to prevent burning. Pass through a sieve, sweeten to taste, and add 1 teaspoon of lemon extract. Sift together 4 level tablespoons of cornstarch and 1 level tablespoon of flour, dissolve in 4 tablespoons of cold water. Melt 1 tablespoon of butter and add ¼ of a teaspoon of salt, pour in 1 cup of boiling water, add the flour and cornstarch mixture and cook until clear. Add the apple pulp, remove from the fire, stir thoroughly. Beat 3 eggs separately, add first the yolks to the apple mixture and lastly the whites of the eggs. Pour into a shallow baking dish and bake in a moderately hot oven until puffed up and brown. Serve at once.

Apple Slump

Pare, core and quarter apples, add a little water and sugar to taste, stew until tender and cover with the following mixture: Sift 1 pint of flour and 1 teaspoon of baking powder, add a pinch of salt and 2 cups of milk, mix and turn out onto a lightly floured board. Roll to a one-half-inch thickness and place over the stewed apples, cover and cook for 10 minutes without lifting the lid. Serve hot with cream and sugar or soft custard.

Apple Stephan

Mix 2 pounds of flour with 1 pound of finely chopped suet, add water to make a soft dough. Roll into a sheet 1 inch thick. Grease a shallow pan with hot suet, sprinkle with 2 tablespoons of brown sugar. Place the crust in the pan and cover with the following mixture: One pound of sliced apples, ½ pound of orange and lemon peel chipped, ½ pound of currants and ½ of shredded citron. Sprinkle with 1 cup of brown sugar, 1 saltspoon each of cloves and cinnamon. Squeeze the juice of 3 lemons over all and add 1 gill of water, cover with a thin layer of paste and bake in a moderate oven for four hours. Serve with sauce.

Apple Tart

Line a deep, round pie tin with rich pie paste and fill it three-quarters full of apples, pared, cored and sliced. Dredge with sugar, put a twist of crust around the edge. When nearly baked, spread with a thin layer of orange marmalade and pour over a rich custard made of 1 cup of milk, 1 tablespoon of sugar and 2 egg yolks. Return to the oven and bake until the custard is set.

Apple Tarts

Line patty pans with nice crust, put in each chopped apples and a little sugar, bake in a moderate oven and let cool. Just before serving, cover each tart with whipped cream and place a drop of currant jelly on the top of each.

Prune and Apple Tart

Stone 1 can of prunes, put them into a pudding dish, add to them 1 pound of sliced apples, 3 tablespoons of sugar, 1 teaspoon of mixed spice and grated rind of half a lemon. Cover with a good pastry and bake in a hot oven until ready.

Apple Taffy

To 1 pound of sugar add ½ tablespoon of vinegar and ½ cup of juice drained from stewed apples. Put the ingredients in an agate sauce pan and let boil to the "crack." Turn onto a buttered platter, and when cool enough to handle pull until white and glossy.

Apple Tapioca

Soak three-fourths of a cup of tapioca for one hour in water to cover, drain, add 2½ cups of boiling water and ½ teaspoon of salt; cook in double boiler until transparent. Core and pare apples, arrange in a buttered baking dish, fill cavities with sugar, pour tapioca over apples and bake in a moderate oven until the apples are soft. Serve with sugar and cream or with cream sauce. Sago may be used instead of tapioca.

Cream Sauce

Mix and beat until stiff three-fourths of a cup of thick cream and one-fourth of a cup of milk, add one-third of a cup of powdered sugar and one-half teaspoon of vanilla.

Apple Tea

Roast tart apples and pour boiling water over them, letting them stand until the water is cold. Sweeten to taste.

Apple Turnovers

Cut ordinary pie crust in squares. Put apple sauce through a sieve, add a few grains of salt and a few gratings of nutmeg. The apple sauce should not be too moist. Trace a figure on one side of the square of paste, on the other side diagonally place a spoonful of the apple sauce. Brush the edges of the paste around the apple with cold water, turn the other half of the paste over and press the edges closely together. Set the turnovers on a buttered baking sheet and brush the tops with slightly beaten white of egg, dust with granulated sugar and bake in a moderate oven.

Virginia Apple Toddy

Bake tart apples until nearly tender, cover with brandy and sugar and bake slowly for two hours. The alcohol in the brandy evaporates, leaving only a delicious flavor.

Apple Water

Wipe, core and pare one large, sour apple, put two teaspoons of sugar in the cavity. Bake until tender; mash, pour one cup of boiling water over it and let stand one-half hour, and strain. This is especially refreshing for fever patients.

Apple Whip

Pare, quarter and core four sour apples, steam until tender, and rub through a sieve; there should be three-fourths of a cup of pulp. Beat on a platter the whites of three eggs, gradually add the apple pulp, sweetened to taste, and continue beating. Pile lightly on a serving dish and chill. Serve with cream or soft custard.

Baked Apples

Wipe and core sour apples. Place in a baking dish and fill centers with sugar and cinnamon, allowing one-half cup of sugar and one-fourth teaspoon of cinnamon to eight apples. Cover the bottom of the dish with boiling water and bake in a hot oven until soft, basting often with syrup in the dish. Serve hot or cold with cream. The centers may be filled with raisins or jelly if preferred.

Panned Baked Apples

Core and cut apples into eighths. Put a layer in a baking dish, sprinkle with two tablespoons of sugar, add another layer of apples and continue until the dish is full. Add to each quart of apples a half pint of water; cover the dish and bake in a quick oven until soft. The skin, which is left on, gives a fine flavor. Serve hot in the dish in which they were baked. This is very nice when served with the meat course at dinner.

Apple Cake

Stew 3 apples and let cool; take ½ cup of butter, 1 cup sugar, 2 eggs, 1 tablespoonful soda, 1 cup of sour milk, 4 cups of flour, cinnamon, cloves and nutmeg; then 2 cups of apple sauce, 2 cups of molasses; bake in moderate oven; when done spread with whipped cream.

Dutch Apple Cake

Mix one cup of scalded milk, one-third of a cup of butter, one-third of a cup of sugar and one-half a teaspoon of salt. When lukewarm add one yeast cake, broken into small pieces, two unbeaten eggs and flour to make a soft dough. Beat thoroughly, cover and let rise until the mixture has doubled its bulk. Beat thoroughly and again let rise. Spread as thinly as possible in a well-buttered dripping pan, brush over with melted butter. Press sliced apples into the dough in even rows. Sprinkle with one-fourth cup of sugar mixed with one-half teaspoon of cinnamon, then with two tablespoons of well-washed currants. Cover and let rise; bake in a moderate oven for 30 minutes. Cut in squares and serve plain, or with whipped cream.

Dried Apple Cake

Chop fine 3 cups of dried apples which have been well soaked. Add 3 cups sugar, 1 cup of raisins and 1 cup of currants; cook in very little water until the apples are soft. When cold, add 3 well-beaten eggs, ½ cup butter, 1 teaspoon each of cinnamon, cloves and allspice, and 3 cups of flour sifted with one teaspoon of soda. Stir well and bake in one loaf. Bake for one hour in a moderate oven.

To Dry Apples

Select sound fruit that has matured. Pare, core and quarter, and slice lengthwise. String and dry near the fire, or spread on frames covered with muslin or netting, and let dry in the sun. If the winter apples are not keeping well, it is a good plan to dry them to prevent waste. Although some have a prejudice against dried apples, they can be made very palatable with a little care.

Dried Apple Roly-Poly

Sift a pint of flour, two tablespoons of baking powder and one-half teaspoon of salt, rub in one tablespoon of shortening. Add two-thirds cup of water, knead quickly and roll out into a very thin sheet. Brush with melted butter. Chop dried apples fine. The apples should have been soaked over night. Sprinkle over the dough the apples and four tablespoons of sugar. Roll up and place in a buttered baking pan, brush with water and bake in a moderately hot oven for three-quarters of an hour. After the roll has been baking for half an hour, baste with a tablespoon of sugar dissolved in two tablespoons of water; return to the oven to glaze. Serve hot with cream and sugar.

Individual Apple Dumplings

Butter six muffin rings and set them on a shallow agate pan which has been well buttered. Fill the rings with sliced apples. Make a dough of 1½ cups of pastry flour sifted several times with one-half teaspoon of salt and three level teaspoons of baking powder. Chop into the dry ingredients one-fourth of a cup of shortening; gradually add three-fourths of a cup of milk or water. Drop the dough on the apples on the rings. Let bake about 20 minutes. With a spatula remove each dumpling from the ring, place on a dish with the crust side down. Serve with cream and sugar, hard sauce or with a fruit sauce.

Apple Jelly

Cut 12 pounds of apples into quarters and core. Put into preserving kettle and add 6 quarts of water; cover and boil gently for 20 minutes. Drain over night and strain the juice. Boil rapidly for five minutes and add one pound of hot sugar to each pint of juice; stir until the sugar dissolves, and boil quickly until it will form a jelly on the spoon or on a cold plate. Add the seeds of two vanilla beans and pour into sterilized glasses. Cover with paraffin. See *Canning and Preserving Fruit*, page 729.

Apple and Barberry Jelly

Equal parts of barberry and apple juice; let boil for 20 minutes and add an equal amount of sugar. Let boil briskly until it jellies on a spoon. Quince, grape, strawberry, raspberry, blackberry, rhubarb, cherry, peach, mountain ash, Oregon grape, wild plum, or almost any highly flavored fruit may be used instead of the barberry juice.

Apple Mint Jelly

Mint jelly may be made by adding a few sprigs of spearmint and enough green vegetable coloring to apple jelly while hot to give it a good color and flavor.

Spiced Apple Jelly

Wash and quarter apples. Cover with three quarts of cold water and one quart of vinegar. Boil until soft. Drain through a colander. Strain juice through a jelly bag. Take equal measures of sugar and juice, two dozen whole cloves and some stick cinnamon. Boil until it jells; strain out the spices.

Apple Preserves

Make a syrup of one pound of sugar and to half a pint of water add the thin outer rind and the juice of one lemon; let boil briskly for five minutes. Drop quarters of apples into the syrup and cook gently until clear; stand aside to cool. When cold, transfer carefully to jars and boil the syrup down. Pour over the apples and seal.

Apple and Quince Preserves

Pare, core and quarter Baldwin apples; add a third as many quinces that have been pared, cored and cut into small pieces and boiled until tender. Make a syrup of the water in which the quinces were boiled and as much sugar as there are apples and quinces. Let boil, skim and drop the quinces and apples in, and let boil for 15 minutes; dip out carefully and put into jelly glasses; boil the syrup until it will jelly and pour over the fruit.

Apple Chips

Cut eight pounds of sweet apples into small pieces. Do not pare. Add four pounds of sugar and one-fourth of a pound of Canton ginger. Add the sugar and ginger to the apples and let stand for 24 hours; add four lemons cut into small pieces, rejecting seeds. Cook slowly for three hours. Put into glasses or stone jars and cover with paraffin.

Preserved Hyslop Crabapples

Cut out the blossom, but leave on the stem. Cover the bottom of an earthenware crock with water; put in a layer of apples. Cover with a thick layer of sugar. Add a layer of crabapples, and continue in this manner until the crock is full. Cover and bake for eight or ten hours in a very slow oven. Cover, and when cool place in a dark, cool place. The result is a delicious, translucent apple in a red jelly.

Preserved Apples (Whole)

Pare and core large, firm apples. Boil

the parings in water for 15 minutes, allowing a pint to each pound of parings. Strain, and add three-fourths of a pound of sugar to each pint of water, as measured at first; add the grated rind of one-fourth lemon to each pint of syrup and return to the kettle and let boil for five minutes, skim and pour over the cold raw apples. Let stand until cold. Then cover and cook slowly until transparent. If directions are carefully followed the apples will remain unbroken.

Apple Pudding

Sift together 1½ cups of flour, 2 teaspoons of sugar, ¼ teaspoon of salt, and 1½ teaspoons of baking powder. Work into the dry ingredients 3 tablespoons of butter and add ½ cup of milk. Butter a quart pudding dish and fill two-thirds full of apples cut in quarters; sprinkle with sugar and add two teaspoons of lemon juice and one-half teaspoon of nutmeg or cinnamon. Cover and bake until soft. Roll the dough mixture out lightly, place over the apples and bake for 20 minutes, and serve with hard sauce.

Hard Sauce

Cream one-third cup of butter, gradually add one cup of powdered sugar and two-thirds teaspoon of vanilla.

Apple and Brown Bread Pudding

Mix two-thirds of a cup of chopped suet with two cups of Boston brown bread crumbs; add two cups of apples chopped fine, half a teaspoon of salt, a cup of raisins dredged with two tablespoons of flour and half a teaspoon of ginger or mace. Beat one egg, add a cup of milk and stir into the dry ingredients. Steam in a buttered mold for two and one-half hours. Serve with creamy sauce.

Apple Christmas Pudding

Pare, core and quarter six tart apples. Add a cup of water, cover and boil quickly for five minutes. Press through a sieve; add a tablespoon of butter and a cup of sugar. Beat three eggs until light; add one pint of milk and a cup of hot boiled rice. Add the apples and bake for half an hour. Lemon or orange rind may be added. Serve cold with cream or lemon sauce.

Apple Corn-meal Pudding

Pare, core and slice very thin twelve medium-sized King apples. To 1 quart of sweet milk add 1 quart of corn-meal, 1 teaspoon of salt, 4 tablespoons of chopped suet, 1 cup of molasses, 1 teaspoon of soda dissolved in the molasses, and the sliced apples. Stir well and pour into a well-buttered pudding mold. Steam for four hours and serve hot with any good pudding sauce.

Apple Custard Pudding

To one quart of pared and quartered apples add one-half cup of water and stew until soft; remove from the fire and add one-half cup of sugar, two tablespoons of butter and the juice and grated rind of one lemon. Mix two tablespoons of flour with two cups of fine bread crumbs, stir into the apple mixture and add the well-beaten whites of two eggs. Pour into a buttered pudding dish and bake for 45 minutes in a moderate oven. Serve with hard sauce.

Bird's-nest Pudding

Core and pare eight apples, put into a deep, well-buttered pudding dish, fill the centers with sugar and a little nutmeg, add one pint of water and bake until tender, but not soft. To two cups of flour add three teaspoons of baking powder, one teaspoon of salt, one pint of milk and the well-beaten yolks of four eggs; stir thoroughly and fold in the whites of four eggs beaten dry. Pour over the apples and bake for one hour in a moderate oven. Serve hot with any pudding sauce.

Indian Pudding With Apples

Scald two quarts of sweet milk, stir in a cup of corn-meal, stir until the mixture thickens. Remove from the fire, add one and one-sixth cups of molasses, one teaspoon of salt, one-half teaspoon each of nutmeg and cinnamon and two cups of sweet apples pared, cored and quartered. Pour into a deep pudding dish and bake for four hours. When the pudding has baked for one and one-half hours, add, without stirring, one pint of cold milk. Serve with cream and sugar or syrup.

Creamy Sauce

Boil one cup of sugar and half a cup of water to the soft ball stage; then pour the syrup in a fine stream over the well-beaten white of one egg; continue beating until cold; fold in one cup of double cream beaten dry; add one-half of a teaspoon of vanilla.

Pan Pudding

Add sufficient milk to a pint of flour to make a stiff dough; knead for fifteen minutes. Cut into four pieces; roll each piece in a thin sheet about one-sixteenth of an inch thick and the size of an ordinary roasting pan. Grease the pan with melted suet, place a layer of the paste in the pan and brush over with melted suet. Mix one-fourth pound of almonds blanched and chopped fine, one cup of chopped raisins, one-half pound of chopped apples and one cup of brown sugar. Put a layer of this mixture on the paste and cover with another layer of paste, brush with suet and continue until all the sheets of paste are used. Brush over with suet and sprinkle with sugar; bake in a quick oven for three-quarters of an hour.

Apple Rice Pudding

Sprinkle one cup of thoroughly washed rice into two quarts of rapidly boiling salted water; boil for 15 minutes and drain. Spread the rice in the center of a good-sized square of cheesecloth. The rice should be about one-half inch thick and cover a space as large as a dinner plate. Pare, core and quarter four good-sized tart apples, sprinkle with sugar and heap in the center of the rice. Gather up the ends of the cloth so that the rice will cover the apples and tie tightly. Boil in a good-sized kettle of boiling water for one hour. This will come out perfectly round if handled carefully. Serve hot with cream or any pudding sauce.

Apple Roly-Poly Pudding

Pare, core and slice sour apples; roll a rich baking-powder dough one-half inch thick, lay the sliced apples on the dough and roll, tuck in the ends and prick deeply with a fork, steam for one and three-fourths hours, or wrap in a well-floured pudding cloth, tie up the ends, plunge into boiling water and boil for three-quarters of an hour. Serve with hard sauce.

Royal Apple Pudding

Select enough large apples to fill a pudding dish; pare, cut a thick slice from the top and save, core and scrape out the centers until only a thin wall is left. To the scrapings add a finely chopped apple, a few chopped almonds and raisins, a little sugar and cinnamon. Press the mixture into the apple shells and replace the lids; place the apples in a well-buttered baking dish; set in a pan of hot water and bake until the apples are tender. Beat four whole eggs until light colored, gradually add a scant cup of sugar and pour over the apples. Bake in a moderate oven until the meringue is done and serve with cream or lemon sauce.

Steamed Apple Pudding

Line a mould with slices of buttered bread, put in a layer of stewed apples, a layer of buttered bread, continue until the mould is filled. Add one pint of milk to two beaten eggs; pour over the apples and bread and steam for one hour. Serve with cream or pudding sauce, or liquid sauce.

Liquid Sauce

Mix one tablespoon of flour with one-half cup of sugar, pour over it one-half pint of boiling water; boil for one minute and pour slowly over one well-beaten egg; add the juice of one-half lemon.

Sago Apple Pudding

Soak one cupful of sago in a quart of water for one hour; core and pare eight apples and place in an agate baking pan. Boil the sago until clear and add one teaspoon of salt; thin with hot water until about as thick as heavy cream and pour over the apples; bake for one hour and serve with cream and sugar.

Shaker Apple Pie

Pare, core and cut into eighths sour apples and put into a lower crust; add half a pint of seeded raisins. Put on

the upper crust, being careful to not let it stick to the lower crust. Bake in a slow oven until the apples are thoroughly cooked and the crust is nicely browned. This will require about forty minutes. While the pie is hot take off the top crust and lay it aside, then with a wooden or silver knife stir the apples and remove any hard pieces that may be left. Add sugar, nutmeg and a small piece of butter and replace the top crust.

Apple Washington Pie

Take two large apples grated, whites of two eggs, cupful of sugar, juice of half a lemon, beat this until thick and white and spread between layers of Washington pie (which is really a plain jelly cake) and then heap some on top.

Pastry

Have everything cold; do not make the dough too moist; use pastry flour if possible; roll only once. Paste kept on ice over night becomes much more flaky than when first made.

To prevent the lower crust from becoming soaked, brush over with white of egg. Brush the edge with unheated white of egg or water and press the two crusts together with the thumb and finger, a pastry roller or the tines of a fork. Always leave an opening in the center of the upper crust that the steam may escape. Bake pies having a cooked filling in a quick oven and those with an uncooked filling in a moderate oven.

Let pies cool upon plates on which they are made, because slipping them onto cold plates develops moisture, which always destroys the crispness of the lower crust.

Beating and Baking a Meringue

Have cold, fresh eggs; beat the whites until frothy; add to each white one level tablespoon of powdered sugar. Beat until so stiff that it can be cut with a knife. Spread on the pie and bake with the oven door open until a rich golden brown. Too much sugar causes a meringue to liquify; if not baked long enough the same effect is produced.

Plain Pastry

Sift one cup of flour and one-fourth teaspoon of salt into a bowl, rub into it five level tablespoons of shortening until the whole is reduced to a fine powder; add cold water, slowly, to make a stiff dough. Place on a slightly floured board and roll into a circular shape to fit the plate. Fit it loosely into the plate, as it shrinks when baked.

Apple Pie

Line a pie plate with good paste. Fill with thin slices of good cooking apples, sprinkle with one-half cup of sugar which has been mixed with a heaping teaspoon of flour and a pinch of salt; cover with an upper crust and bake in a moderate oven for half an hour.

Apple Custard Pie

Heat a pint of milk steaming hot and pour it into a mixture of three eggs slightly beaten, three heaping tablespoons of sugar, a pinch of salt and a very little nutmeg or lemon. Grate one cup of apple, using mellow, slightly tart fruit; add to the milk mixture and bake in a very moderate oven without an upper crust. If the pie is baked too quickly the apple will separate from the milk.

Dried-Apple Pie

Soak and stew apples until tender, pass through a sieve and add sugar, a little orange or lemon rind and a small amount of butter. Fill and bake as any other pie. Serve warm with sweetened cream.

Salad

For salad dressings see *Dressings for Salads*, under *Vegetable Recipes*, this section.

Apple Peanut Salad

Pare, core and chop slightly acid apples and mix them with half as much chopped celery. Mix a dressing of peanut butter, using five tablespoons of lemon juice to one tablespoon of peanut butter. Mix dressing through the apples and celery and season with salt and cayenne pepper. Chill the salad and serve on lettuce and garnish with peanuts.

Red Apple Salad

Make apple cups of bright red apples and put them into water containing a little lemon juice until time to fill them. Mix some of the apple pulp with celery, grapefruit carpels and mayonnaise dressing and fill the apples. Garnish with red maraschino cherries that have been drained and stuffed with blanched hazelnuts. Serve on lettuce leaves with wafers which have been spread with cream cheese mixed with tomato catsup.

A New Apple Salad

Beat one-half a cup of double cream, a tablespoonful of lemon juice and one-fourth of a teaspoonful of salt until firm throughout. Cook three apples, cored and pared, in a syrup of equal measures of sugar and water, with two or three cloves and an inch of stick cinnamon, and set aside to become thoroughly chilled. Chop fine four maraschino or candied cherries and eight or ten pecan nut meats or blanched almonds. Wash three small heads of lettuce, remove the outer leaves and cut the stalks so that the heads will stand level. Place the lettuce on plates, with an apple in the center of each. Mix the nuts and cherries through the cream and pour it over the apples.

Apple, Orange and Peach Salad

Equal parts of apples, peaches and oranges are cut into cubes and mixed with cream dressing. Serve in apple shells or in the rind of the oranges.

Apple and Nut Salad

Mix one pint of celery and one pint of apples cut into small match-like pieces with one-half pint of English walnut meats broken into small pieces. Dress with boiled salad dressing and serve in apple cups or on lettuce leaves.

Salad Dressing Made With Butter

Cream two tablespoons of butter. To the beaten yolks of two eggs add one tablespoon of cold water, three tablespoons of tarragon vinegar, one-quarter of a teaspoon of salt, a dash of cayenne and one-eighth of a teaspoon of mustard. Beat well and cook in a double boiler until very thick. Remove from the fire and stir in the creamed butter. When very cold add two-thirds of a cup of whipped cream.

Apple Chicken Salad

Take six ripe apples and scoop out the centers. Fill them with cold cooked chicken, minced fine, seasoned with finely minced green peppers and salt, with enough cream to moisten. Place apples in a steamer and cook until almost tender. Put them on ice and serve with mayonnaise on lettuce.

Cream Salad Dressing

Cook one-third cup of cream, two slightly beaten yolks of egg, two tablespoons of sugar and two tablespoons of lemon juice in a double boiler until as thick as soft custard. Add a pinch of salt and strain.

Apple and Date Salad

Cut pared apples into tiny strips. Cut dates into similar pieces, using about one-fourth as much date as apple. To each pint of material add two tablespoonfuls of olive oil and turn the mixture over again. Let stand closely covered for half an hour. Turn into a bowl lined with lettuce leaves. Serve with bread and butter at luncheon or supper.

Apple and Banana Salad

Slice bananas and roll in lemon juice and sugar; mix with an equal amount of sliced apples. Serve with boiled dressing or with mayonnaise dressing.

Apple and Cabbage Salad

Shave cabbage fine and soak for one hour in celery water, made by adding one teaspoon of celery salt to each quart of water. Drain and dry on a soft towel. Add an equal amount of apple cut into match-like pieces; mix with boiled dressing.

Apple and Celery Salad

Pare, core and cut into three-eighths of an inch cubes mellow apples; mix with half the amount of celery cut into one-fourth inch slices; add a little salt and put into a salad bowl. Mix with mayonnaise dressing and serve on lettuce leaves or garnish with celery tops.

Apple and Cheese Salad

Mix chopped pecans with twice their bulk of cream cheese, adding a little thick cream to blend the mixture. Season with pepper and salt and make into tiny balls. Pare mellow, tart apples, core and slice across the center into rings about one-half inch thick. Arrange rings on lettuce leaves and place several cheese balls in the center. Serve cream salad dressing.

Cider Apple Sauce

Reduce four quarts of new cider to two by boiling; add enough pared, cored and quartered apples to fill the kettle. Let cook slowly for four hours. This is very nice when served with roast pork.

Apple Sauce

Cut into eighths and core unpared King or Baldwin apples; cook quickly in thin syrup. The skins give it a pretty pink color.

APRICOT

Apricot Ice

One can of apricots, five oranges, two lemons, whites of four eggs, one quart and one cupful of sugar, one quart of water, one quart of cream.

The apricots, oranges and lemons are pressed through a sieve. Then boil the sugar and water to a syrup and allow to cool. Mix the fruit and syrup and add the stiffly-beaten whites of the eggs. After this start to freeze, add the cream and freeze until almost solid, then remove the dasher and pack well. This will be sufficient for one gallon. This ice is pleasing to the eye as well as to the palate.

BANANA

Apple and Banana Salad. See *Apple Recipes*, this section.

Banana Salad

Make a good boiled salad dressing and when it is cold stir in a cup of whipped cream; chop some peanuts quite fine. Cut the bananas lengthwise then halve the pieces, roll the bananas in sugar, then in the salad dressing and then in the chopped peanuts, and place in crisp lettuce leaves. Sprinkle a few nuts on top and spoonful of the dressing.

BARBERRY

Barberry Jelly

Barberry Jelly. See *Barberry and Apple Jelly*, under *Apple Recipes*, this section.

BLACKBERRY

Blackberry and Apple Jam

Use equal weights of nice ripe blackberries and fresh apples, peeled, cored and chopped. Put on to cook with equal weight of sugar and half a cupful of cold water for every pound of sugar. Let the sugar melt and the fruit heat slowly until it reaches the boiling point, stirring it now and then. When it boils put where it will cook very gently for an hour, or until the fruit looks clear and is as thick as jelly when tested in a saucer. Let it cool a bit before putting in jars.

Blackberry Roll

Make a plain paste as for fruit pies, and make it stiff enough to prevent the berries from escaping. Roll this out in a sheet at least 12 inches in length to serve a family of six. Spread with a quart of fresh blackberries, not letting them get too close to the edge. Some leave the berries unsweetened, others like them sugared and also dredged with a little flour and flavored with a dash of nutmeg. Roll up the paste, turning in the edges; then fold up a piece of cheesecloth, tying the ends with cord. Drop into a kettle of boiling water and keep it boiling continuously for at least two hours and a half. Take out, drain and carefully remove the cloth, and serve at once with sugar and cream or hard sauce.

Wild Grape or Blackberry Pickles

Pick over carefully, rejecting all unsound ones. Put into any kind of jar or bottle, then pour over molasses. Keep filling up as it settles—which will take time. These cannot be sealed; just tie over the top a piece of cotton cloth and set away. They will soon be "sharp."

The sweet pickle syrup given above can be used for peaches, plums, apricots and crabapples.

Canned Blackberries. For canning and preserving blackberries, see *Raspberries*, this section.

Blackberry Jelly. See *Barberry and Apple Jelly*, under *Apple Recipes*, this section, also page 729.

CHERRIES

Cherry Cake

A delicious cherry cake can be made by putting stale bread into a pint and a half of scalded milk, which cover and let stand for 40 minutes. Beat into the bread and milk, one by one, the yolks of six eggs and a half a cupful of sugar. To this add the beaten whites of the eggs and three pounds of stoned cherries. Put the mixture into a shallow, well-buttered baking tin, bake one and a half hours, turn out while hot and sprinkle plentifully with powdered sugar and a little ground cinnamon.

Cherry Pie

Fill a fairly rich crust not quite full with stoned ripe cherries, sprinkle evenly over them a heaping teaspoonful of cornstarch, or a tablespoonful if they are very juicy; add a teacupful of sugar, and dot with small pieces of butter. Cover with paste, wet the edges of the upper and under crust, press well together, brush over with well-beaten egg; bake in a hot oven till ready. Dust over with fine sugar.

Cherry Roll

Early in the morning pit a box of fine cherries and cover them with a cupful of granulated sugar and let them stand until needed. Sift two cupfuls of flour with two teaspoonfuls of baking powder, one of sugar, a quarter of a teaspoonful of salt. Rub in two tablespoonfuls of butter and mix to a dough with two-thirds of a cupful of milk. Roll out into a long, thin sheet; sprinkle with two tablespoonfuls of sugar; spread with the cherries; add a grating of nutmeg and roll up, pinching the ends so that the juice will not escape. Boil or bake this as you prefer.

Cherry Salad

Cherry salad is most appetizing, and a cream mayonnaise seems the dressing best adapted to use with it. Wipe cherries, remove stems and stones and fill cavities thus made with filberts. Arrange in nests of lettuce leaves and garnish each nest with three selected cherries, from which neither stems nor stones have been removed.

Spiced Cherries

Boil three cupfuls of cider vinegar with two inches of cinnamon stick and one tablespoonful of cloves tied in a bag. Then add four and a half pounds of lump sugar and boil 15 minutes more, skimming well. Put in seven pounds of stoned cherries and cook very gently for half an hour. Lift out the fruit with a skimmer and boil the syrup down until it is very thick. Put the cherries into jars and keep hot, add the syrup, then close and seal. These are very good with cold meats.

Cherry Wine

Take four quarts fruit, either sweet or sour, place in a mortar and slightly bruise without crushing the stones. To this add three quarts water and let stand in a jar 48 hours. Strain, and to each four quarts juice add three and one-half pounds sugar if the fruit is acid, or eight pounds if sweet. Fill into jars, reserving a bottle of the liquid, with which to keep the jars filled while fermenting. Cover the openings with a thin cloth. After the fermentation ceases cork tightly and keep in a cool place three months; drain off carefully and bottle.

Canned Cherries. For canning cherries, see *Canning and Preserving Fruits*, page 725.

Cherry Jelly. See *Barberry and Apple Jelly*, under *Apple Recipes*, this section.

CRANBERRY

Cranberry Muffins

Beat one-third cup of butter to a cream; gradually beat in one-fourth cup

of sugar, then one egg, beaten light, three-fourths cup of milk and two cups of sifted flour, sifted again with two rounding teaspoonfuls of baking powder and half a teaspoonful of salt. When well mixed, beat in one cup of cranberries cut in halves. Bake about twenty-five minutes in a well-buttered muffin pan.

Cranberry Sauce

Wash and pick over one quart of cranberries. Put in agate saucepan with one cup of water. Cook until very soft. Put through a colander or sieve to remove the skins. Add three-fourths cup of sugar, and stir until it is dissolved. Serve either hot or cold.

CUMQUAT

Apple-and-Cumquat Salad

Wash the cumquats in cold water and dry each one separately, on a soft cloth, to clean thoroughly. Cut the fruit into quarters, lengthwise through pulp and skin, then cut the quarters into three or four lengthwise slices, discarding the seeds. Cut an equal bulk of apples into match-like pieces and pour over the apple (for a pint) two or three tablespoonfuls of lemon juice in which one-fourth of a teaspoonful of salt has been dissolved. Pour two or three tablespoonfuls of oil over the prepared cumquat and toss thoroughly; add the apple and toss again. Serve on heart leaves of lettuce, washed and carefully dried. This salad may be served with meats or with bread and butter.

CURRANT

Xmas Currant Loaf

(Overnight Method)

Two cakes Fleischmann's yeast, one pint lukewarm milk, one pint lukewarm water, one tablespoonful salt, one cup butter and lard mixed, one cup granulated sugar, one cup chopped raisins, two cups cleaned currants, six pints sifted flour, one teaspoonful ground mace, one teaspoonful cinnamon.

Make sponge from milk, water, yeast and two pints of the flour. Cover and set aside to rise for about one hour. Then add sugar, shortening, salt, fruit, thoroughly floured, spices; add remainder of flour gradually. Knead thoroughly, cover and set aside to rise in a warm place, free from draft, for about eight and a half or nine hours, or until very light.

In the morning divide into loaves, put into well-greased pans, cover and let rise for one and one-half hours, or until real light. Bake one and three-fourths hours in a slow oven.

This amount makes four ordinary loaves or three large ones. The whole process takes about fourteen hours.

If a richer cake is desired, add more fruit and some chopped citron.

This bread is lighter and in every way much superior to that made from a bread dough.

Currant Vinegar

A fine vinegar may be made from currants by simply pressing the fruit to a mash; let it stand over night, then drain the juice off clear and fill the bottles to the brim. Set them, uncorked, in the sun or in a warm place until fermentation ceases. Any little impurity that rises skim off with a piece of blotting paper, and cork the bottles well. White currants are excellent for a delicate, pale vinegar.

Currant Jelly. For method of making currant jelly, see *Canning and Preserving Fruit*, page 729.

DATES

Wheatena With Dates

Three-fourths cup of wheatena, one teaspoonful of salt, three-fourths cup of cold water, two and one-fourth cups of boiling water, one-half pound of prepared dates (or one cup).

Mix the wheatena, salt and cold water. Add to this a little of the boiling water, then pour the paste into the remainder of the boiling water and let it boil five minutes. Put it into a double boiler and cook for 30 minutes. Add the dates (stoned, washed very thoroughly and cut into pieces) when the wheatena is put into the double boiler. Serve either hot or cold, with milk or cream and sugar. It may be molded in cups and chilled before serving.

An Excellent Dessert

One pint of cream, white of one egg, sugar to taste, one-half cupful of ground walnuts, 12 figs, six dates.

Beat up the cream until stiff with the white of the egg, which adds to the stiffness and bulk. Sweeten the cream to taste, add the ground walnuts, the figs and the dates cut into small pieces. Mix carefully and put into a wet mould; cover tightly and pack in ice and salt. Allow it to remain so for four hours. This quantity will serve eight persons.

FIGS

Sliced Figs in Sherry Wine Jelly

One tablespoonful of granulated gelatine, one-fourth cup of cold water, three-fourths cup of boiling water, one-half cup of sugar, one-half cup of sherry wine, juice of one-half a lemon, five or six figs, whipped cream.

Soften the gelatine in the cold water, dissolve in the boiling water; add the sugar and stir occasionally until cold. Add the wine and lemon juice. Let a mold holding a scant pint become chilled in cold or ice water. A fluted mold is good for this dish. Cut the figs in slices, dip some of these in the jelly mixture and use them to decorate the mold; then fill the mold, alternately, with slices of figs and the mixture, letting the jelly "set" partially, each time, before adding the slices of figs. When the jelly is unmolded garnish with whipped cream, put on with bag and tube and bits of fig. Orange or lemon juice may be used in place of the sherry wine.

Macedoine of Midwinter Fruit

Five or six cooked figs, one banana, one grapefruit or two oranges.

Cut the figs in smooth slices of the same size, scrape the banana and cut in thin slices; remove the grapefruit or orange pulp in neat pieces from the respective fruits, cut in halves. Save all of the juice. Dispose the fruit in glass or china saucers, reserving a slice of banana and five or six slices of fig for each saucer; divide the fruit juice among the dishes; set the slices of banana in the center and arrange the slices of fig from the banana to the edge, like the spokes of a wheel. Sprinkle with powdered sugar before finishing the dishes, or pass the sugar at time of serving.

Fig Whip

Five cooked figs, four whites of eggs, one-half cup of sugar, one-fourth teaspoonful of salt. Boiled custard made of one pint of milk, four yolks of eggs, one-third cup of sugar, one-fourth teaspoonful of salt.

Cut the figs in tiny bits; beat the whites dry; gradually beat in the sugar and salt, then fold in the figs. Turn into a buttered-and-sugared dish. Bake on many folds of paper and surrounded with boiling water. The water should not boil during the cooking. The whip or souffle is done when firm in the center. Serve hot with boiled custard, or with cream and sugar.

Fig-and-Orange Salad

One-half pound of cooked figs, three oranges, one head of lettuce, three or four tablespoonfuls of oil, one or two tablespoonfuls of lemon juice, one-fourth teaspoonful of salt.

Dispose the heart leaves of the lettuce, carefully washed and dried, to form a bed; on this turn the pulp of the oranges, freed from skin membrane and seeds; above dispose the figs, cut in narrow slices. Dissolve the salt in the lemon juice, add the oil, mix thoroughly and pour over the whole; turn the fruit over and over, and serve at once.

Steamed Fig Pudding

One pound of figs, one-half cup of nuts, one-half pound of suet, two cups of bread crumbs, two cups of milk, three-fourths cup of sugar, one teaspoonful of salt, one teaspoonful of cinnamon, one teaspoonful of mace, one-third teaspoonful of cloves, four yolks of eggs, four whites of eggs.

Chop the figs, nuts and suet together (cook the figs a few moments and they can be chopped more easily), mix the sugar, salt and spices and add to the beaten yolks; mix the bread crumbs

through the fig-suet mixture, then mix in the yolks and sugar and, lastly, add the whites, beaten dry. Steam in a well-buttered mold four hours. Serve with hard or liquid sauce, or both.

FRUIT SALAD

One teaspoonful banana extract, one-half teaspoonful lemon extract, one-half teaspoonful almond extract, one pint canned pineapple, one pint marshmallows, one-half pound white grapes, one-fourth pound English walnut meats, six egg yolks, two tablespoonfuls flour, three tablespoonfuls vinegar, two tablespoonfuls sugar, one-half teaspoonful salt, one cupful cream.

Cut the pineapple into small pieces; divide the marshmallows into quarters, halve and seed the grapes, and cut the walnuts into small pieces. Mix the sugar and flour well and beat into the eggs; add vinegar, banana extract, almond extract, lemon extract and salt.

Cook in a double boiler until it begins to thicken, stirring constantly, then take from the stove and beat till smooth, adding the cream gradually. When cold, mix with the fruit and set aside to chill. This salad should be prepared two hours before serving.

GRAPE

Sillabub

One quart of fresh cream, white of four eggs, one glass of grape juice, two small cups of powdered sugar; whip half the sugar with the cream, the balance with the eggs; mix well; add grape juice and pour over sweetened strawberries and pineapples or oranges and bananas. Serve cold.

Bohemian Cream

One pint thick cream, one pint grape juice jelly; stir together; put in cups and set on ice. Serve with lady fingers.

Besides the recipes just given, many more are enumerated, such as grape ice, grape lemonade, grape-water ice, grape juice and egg, baked bananas, snow pudding, grape gelatine, junket and grape jelly, tutti-frutti jelly, grape float, grape jelly, grape juice plain, grape soda-water and scores of others.

Grape Nectar

Take the juice of two lemons and one orange, one pint of grape juice, one small cup of sugar and a pint of water. Serve ice cold. If served from punch bowl, sliced lemon and orange add to the appearance.

An Invalid Drink

Put in the bottom of a wine glass two tablespoonfuls of grape juice; add to this the beaten white of one egg and a little chopped ice; sprinkle sugar over the top and serve. This is often served in sanitariums.

Grape Punch

Boil together one pound of sugar and half a pint of water until it spins a thread; take from the fire and when cool add the juice of six lemons and a quart of grape juice. Stand aside over night. Serve with plain water, apollinaris or soda-water.

Grape Sherbet

For eight persons mix one pint of grape juice (unfermented), juice of lemon and one heaping tablespoonful of gelatine soaked in cold water and then dissolved in boiling water; freeze quickly; add beaten white of one egg just before finish.

Grape Ice Cream

One quart of unfermented grape juice, one quart of cream, one pound of sugar and the juice of one lemon.

Wild Grape Jelly for Game

One gallon of green grapes, one pint of vinegar, two tablespoons of whole cloves, two tablespoons of stick cinnamon, one and one-half quarts of sugar. Cook the ingredients except the sugar until the grapes are tender. Strain through a jelly bag. Put the juice in the kettle and boil for 20 minutes. Add the sugar heated and cook until it will jelly

—about five minutes will be needed. Turn into sterilized glasses and seal as directed.

Green Grape Jam

Pulp the grapes, putting the skins in one kettle and pulp in another. Bring pulps to boiling point and when soft enough rub through a coarse sieve. Add the skins, and measure. To every pint of the grapes add three-quarters of a pound of sugar, and finish as with other jams.

Grape Consort

One basket Concord grapes, five pounds sugar, two pounds seeded raisins, one-half pint shelled walnuts broken, juice of three lemons.

Pulp the grapes, put the seeds on and boil till the seeds go to the bottom, put through colander, put the juice on rinds, add the sugar, cook 10 minutes, add the raisins and lemon and cook till like jam. Remove from fire, stir in the broken walnuts and put in jelly glasses. It is then ready for use.

To Can Muscat Grapes

Pick them from stems in clear water and drain. Have jars heated and fill with grapes. Then pour medium hot water over them and let stand for one or two minutes. Pour this water off and have ready a boiling hot syrup made of one-half cup sugar and water enough to cover a quart jar of grapes; then seal. Grapes put up this way retain their natural flavor and keep whole and firm.

To Keep Grapes Fresh

Select perfectly whole grapes and wrap each bunch in soft tissue paper, or a very soft, thin paraffin paper—something that will fold softly and closely over the fruit, and that can be twisted firmly over the stem end. Before wrapping in the paper it is a good plan either to single the ends of the stems or to dip them in melted paraffin. Grapes treated in this way may easily be kept fresh for Christmas and New Year's.

Grape Jelly. For method of making jelly, see *Canning and Preserving Fruits*, page 729.

GRAPEFRUIT

Grapefruit, Plain Service

Cut the grapefruit into halves, crosswise, to form two portions. Remove the seeds. With a thin, sharp-pointed knife cut around the pulp in each little section of the fruit, so that each triangular section of pulp may be lifted out with an orange spoon or fork. Set the halves of fruit on plates. A lace-paper doily is often laid between the fruit and plate.

Grapefruit With Powdered Sugar, Etc.

Prepare the grapefruit as above, but also run a sharp knife between the membrane that separates the sections and the skin, so that all unedible membrane and the white center may be lifted out in one piece. Put a rounding teaspoonful of sifted powdered sugar in the center of each half of fruit. Finish with a maraschino cherry and a teaspoonful of the liquid from the bottle, or use a tablespoonful of sherry wine.

LEMON

Lemon Marmalade

Take 12 good lemons, wash well, cut in quarters and slice the skin very thinly; remove seeds and cut up the pulp roughly, and put all together in the preserving pan with six or seven quarts of water and let this soak for 12 hours or more; then boil this all gently together for two hours. Weigh the mixture and for each pound take an equal weight of sugar and boil till clear and beginning to set, when it must be potted and tied down whilst still hot.

Lemon Filling for Cake

Beat the yolks of two eggs; add one cup of sugar, gradually, the grated rind and juice of one lemon and two tablespoonfuls of butter. Let cook over hot water, stirring constantly, until the mixture thickens. Use when cold. If a

thicker consistency be desired, use one whole egg and the yolk of another, instead of two yolks.

Lemon Butter. See *Cider Products Made on Farm*, page 811.

LOGANBERRY

For recipes for loganberry juice, see under *Loganberry*, page 1250.

Jelly. For method of making jelly, see *Canning and Preserving Fruit*, page 729.

Canning. For method of canning, see *Raspberry*, this section. Loganberries will require more sugar than raspberries.

MINCEMEAT

Mincemeat

Use good tart apples; chop moderately fine. If it is desired to have the apples show white in the finished meat, drop them into a basin of cold water to which a small quantity of salt has been added, keeping the apples wet with the solution. While chopping be careful to remove cores and seeds. Wash and clean the raisins and currants, hand-picking to remove stones. Chop the orange and lemon peel very fine and the citron coarse. Select good, fresh, firm suet; trim out all kernels, meat, bloody parts and the larger strings. Meat as cooked by many simply forms a tasteless and expensive filling. To cook meat properly it must be first plunged in a boiling hot solution of salted water (one and a half tablespoons of salt to a quart of water), then changed to an ordinary solution, where the cooking is finished. Trim out all fat and gristle and chop quite fine. In mixing, always first mix the apples and suet, then spread out over the bottom of pan and add the other dry ingredients in even layers. Turn over with a wooden spoon. Make a syrup (sugar and water), add other juices (if recipe calls for it), turn over again, then allow to soak 24 hours, or long enough for the fruit to swell out plump; mix again and store away in glass jars or anything suitable.

Mincemeat No. 1

Two pounds sugar, two pounds meat, two pounds apples, three pounds raisins, two pounds currants, one and three-fourths pounds suet, one-half pound lemon, one-half pound citron peel, one quart brandy, juice of four lemons and grated rind of three, one tablespoon cinnamon, three nutmegs, one teaspoon cloves (ground), salt to taste, two pounds sugar. Cider may be substituted for brandy.

Mincemeat No. 2

Four pounds fresh beef, four pounds apples, one pound suet, one pound currants, one pound raisins, one-fourth pound mixed peel. Proceed as before, chopping apples, stoning raisins, etc. Put it over a fire with one pound sugar dissolved to a syrup in water, two quarts of cider and one-half pint of brandy. Add, while heating, the spices as follows: One tablespoonful of cloves, one of allspice, one of salt, one of ginger and one of ground mace, with one nutmeg grated, and the juice and rind of one lemon. Let it all boil together.

Christmas Pudding

One pound sultanas, one pound suet, one pound sugar, one pound raisins, one pound currants, one-half pound flour, one-half pound bread crumbs, one-half pound mixed peel, one-fourth pound blanched almonds cut small, the juice and grated rind of two lemons, eight eggs, one-half pint of milk, two teaspoons of baking powder, two pinches of salt, nutmeg, mace and cinnamon. Dry-clean the currants; clean and chop suet fine; chop peel fine; mix all dry ingredients together; add other ingredients and steam until done.

NUTS

Chocolate Nut Fudge

One teaspoonful clove extract, one-half cupful molasses, one-half cupful cream or milk, two cupfuls brown sugar, one cupful chopped nut meats, two heaping tablespoonfuls butter, two squares bitter chocolate.

Melt the chocolate in a saucepan, add

the molasses, sugar, butter, milk or cream. Stir them over the fire till they boil for four minutes. Test it in cold water and remove from the fire when it forms a soft ball or registers 240 degrees Fahrenheit on the thermometer.

Add the extract and nuts and beat until smooth. Pour into a buttered pan and cut into squares when cold.

Queen of Nut Candies

One teaspoonful mace extract, one teaspoonful almond extract, one and a half cupfuls molasses, three-fourths cupful granulated sugar, three-fourths cupful butter, one-half pound figs, one cupful pecan nut meats, one cupful hickory nut meats, one and three-fourths cupfuls English walnut meats, one and one-fourth cupfuls almonds, pinch of baking soda.

Put the molasses and sugar into a saucepan and boil until it forms a hard ball when tried in cold water, then add the butter and continue boiling until it is brittle when tested in cold water. Now add the soda, the figs put through a meat chopper, the extracts and the nuts. The almonds should be blanched and the other nuts should be carefully picked.

Pour into a well-buttered pan or mold and leave in a cool place for 12 hours. Turn out and cut in slices.

Pecan Nut Roast

Two-thirds cup pecan meats; one-third cup blanched almonds, chopped fine; one cup fine dry bread crumbs seasoned with chopped onion, pinch of sage and thyme; pepper and salt to taste. Mix with one cup cream or milk, bind with two well-beaten eggs, bake three-quarters of an hour in oiled dish.

Pecan Panoche

Make a custard of one quart milk, four well-beaten eggs, one cup sugar. In each custard cup put two tablespoonfuls very finely ground pecan meats. Fill with liquid, stir well, bake in pan of water in moderate oven until set. Add to each cup just before serving one heaping teaspoonful whipped cream flavored lightly with bitter almond. Serve very cold.

Pecan Surprise Salad

Make good-size balls of hearts of head lettuce, fill inside with one cup coarsely ground pecan meats, one cup chopped tender celery, half cup diced tomato, well mixed. Keep in refrigerator and serve very cold with mayonnaise dressing.

Squirrel Pecan Dainty

Chop or grind three pounds stoned washed dates, add two cups finely ground pecan meats, mix and knead to stiff dough. Form rolls three inches in diameter, cut with sharp knife into slices one-fourth inch thick, roll in powdered sugar, put in tin boxes and keep in cool place as healthful sweet for children. Will keep indefinitely if cool.

French Almond Cake

One-half teaspoonful almond extract, one-half teaspoonful orange extract, one-half teaspoonful vanilla extract, one-fourth lb. almonds, three bitter almonds, one-half cupful sugar, one-half cupful butter, three eggs, pinch salt, one lb. puff pastry.

Blanch the almonds and dry them thoroughly. Pound them, adding one of the whites of eggs lightly beaten; then add the sugar and butter beaten to a cream, salt, almond extract, orange extract, vanilla extract, one egg well beaten, and, when well mixed in, add a second egg.

Divide the pastry into two parts, roll out one to half an inch in thickness, put it on a baking tin, spread the almond paste on it, so that it does not come quite to the edge, but leave an inch width all round, and brush the edge lightly with water. Roll out the other half of the pastry and lay it on the top; press the edges firmly together, trim the cake round neatly, and ornament the top with the point of a knife. Beat up the remaining yolk of egg with a little water, and brush the top of the cake over with it.

Bake in a hot oven for forty-five minutes. Let the cake cool a little and sprinkle sifted sugar over the top.

OLIVES

Beef Grenadins With Olives

One tablespoonful onion extract, one-fourth teaspoonful mace extract, one teaspoonful celery extract, two lbs. steak, one carrot, one turnip, one-half lb. fat bacon, bunch sweet herbs, salt and pepper to taste, one heaping tablespoonful butter, one tablespoonful flour, 18 large olives.

The steak should be one inch thick. Cut it into small rounds, and carefully lard each round on the top with neatly cut lardoons cut from the bacon one inch long and a quarter inch square. Prepare the vegetables and cut them in slices, and lay them in the bottom of a saucepan, add the herbs, salt, pepper, onion extract, mace extract, and celery extract. Lay on the top the grenadins, and pour round a little boiling stock or water; allow these to simmer slowly for one and a quarter hours. Remove the grenadins into a baking tin with a few tablespoonfuls of gravy set in a hot oven to brown. Meanwhile, heat the butter in a saucepan until brown, add the flour, strain into this the gravy; then add the olives, parboiled, stoned, and chopped; boil for fifteen minutes. Dish the grenadins in a ring on a hot platter, and pour the gravy and the olives in the center.

ORANGE

Orange Marmalade

Take nine oranges and six lemons and prepare the same as for lemon marmalade, using less sugar if sweet California oranges are used.

Orange Custard

Peel and cut up two oranges in dish you are to serve desert from. Pour over them the following custard: One and a half cups of milk, a heaping tablespoon of cornstarch, a pinch of salt, two tablespoons of sugar, two eggs. Heat milk in double boiler, saving out a little to make a smooth paste with cornstarch.

Slowly add this paste to the hot milk, stirring the milk as you add. Cook 15 minutes, stirring constantly. Beat the sugar and salt with the yolks of the eggs and slowly stir into the thickened milk. Cook for a minute or two stirring all the time. Remove from the hot water and when slightly cooled add the beaten whites and the flavoring. Pour over oranges, chill and serve.

PEACH

Peach Pie

One teaspoonful peach extract, a few drops yellow color, one-fourth teaspoonful rose pink color, peaches, sugar to taste, one pint whipped cream, pie crust.

Line a deep pie plate with a rich pie crust and bake until done. Peel and chop some peaches, sprinkling them over with sugar to taste.

Fill the pie with these and bake until they are tender. Cool the pie. Beat up the cream, add the peach extract to it and divide it into two portions. Add the yellow color to one portion. Decorate the pie with the white cream and the yellow cream using a forcing bag and tube. Put the rose pink color into a saucer and rub enough granulated sugar into it to obtain a prettily colored decoration. Sprinkle a little of it over the top of the cream. The colored sugar may be kept in a bottle for future use.

Compote of Peaches With Rice

Cook quarter pound of rice in double boiler in sufficient milk to cover. When nearly cooked add a little vanilla and one tablespoonful of granulated sugar. Take saucepan off fire and keep it covered for 10 minutes. Butter a mold and mix a little butter with the rice and press it down into the mold. Fill the center until quite full with halves of peaches which have been stewed for 10 minutes in a little well-sweetened water, then pour the syrup of the peaches over it. If desired, stick the halves of sweet almonds in the center of each peach.

Canned Peaches. For method of canning peaches, see *Canning and Preserving Fruits*, page 725.

Peach Butter. See *Cider Products Made on Farm*, page 811.

PEAR

Preserved Pears

Pears for preserving should be firm. Take, say, 12 Bartlett pears, peel, core and cut in halves (quarter if large). Take two and one-half pounds of sugar, the thin rind and juice of three lemons, and about three pints of water. Put in a preserving pan and boil for about 20 minutes, removing any scum; then put in the pears and boil till tender. Take up the pears carefully and put into sealed jars, previously warmed; then if the syrup seems thin and watery boil it up quickly for a few minutes and pour over the pears, covering them. The addition of the lemons brings out the true flavor of the pears. A few cloves added to the syrup is preferred by many instead of lemons.

See *Canning and Preserving Fruits*, page 725.

Pear Butter. See *Cider Products Made on the Farm*, page 811.

PERSIMMON

Persimmon (Japanese) Salad

Beginning at the blossom end, score the skin of Japanese persimmons in straight lines nearly to the stem end; then with a sharp-pointed knife loosen the skin from the pulp, thus forming petal shapes. Score the pulp directly under the scorings made on the skin, and cut through to the center, thus partially separating the fruit into sections similar to the sections of an orange. Set each fruit on heart leaves of lettuce. Bend the sections of peel (petals) over the lettuce. To a cup of mayonnaise dressing add about one-third of a cup of cream, beaten firm, also a few grains each of salt and paprika. Serve the dressing in a bowl apart.

PRUNE

Prune Souffle Pudding

Fourteen large prunes, whites of six eggs, one cupful of sugar, one-fourth cupful of chopped walnuts.

After the prunes have been boiled until soft remove the stones and chop fine. Beat the whites of the eggs until very light; beat in the sugar gradually, then add the prunes and nuts and turn into a buttered baking-dish. Bake in a slow oven for thirty minutes. It must be served as soon as cooked, as the pudding will fall. It is delicious with cream.

Spiced Prunes

Wash two pounds of prunes. Boil down a pint of vinegar and three pounds of sugar, with a handful of whole spices, until it is very syrupy. Add the prunes to this mixture and let them simmer very gently till they are soft.

Canned Prunes. For method of canning, see *Canning and Preserving Fruits*, page 725.

Prune and Plum Butter. See *Cider Products Made on the Farm*, page 811.

QUINCE

Apple and Quince Jam

When preserving quinces you are sure to have some left-over juice. To a pint add a pound of sliced apples and three-fourths of a pound of granulated sugar. Boil two hours, stirring well to prevent burning. If you have no left-over juice, cover the cores and parings of the quinces with cold water, heat slowly until they are soft; then strain off the juice and add to the apples and sugar.

Quince Preserves. See *Apple and Quince Preserves* under *Apple Recipes*, this section.

RAISIN RECIPES

How to Cook Raisins

Raisins are delicious when returned to their original form as near as may be possible. Soak them, simmer them. The result will be most pleasing. Fireless cooker gives perfect results. Raisin juice extracted in cooking is simply unfermented grape juice and is very pleasing and nourishing to weak stomachs.

In bringing out the good qualities of puddings, cakes, and mince pies, the raisin has no rival. Thanksgiving without raisins would be like Thanksgiving without turkey. But there are many uses to which raisins are adapted that are just becoming known. They are

good, every-day food — an unrivaled health food. The following recipes convey some of the new ideas.

Raisin Puffs

Two eggs, one-half cup butter, three teaspoons baking powder, two tablespoons sugar, two cups flour, one cup milk, one cup seeded raisins chopped fine. Steam one-half hour in small cups.

Sweet Raisin Rolls

One quart milk, four ounces lard, four ounces sugar, one and one-half ounces salt, yolks of five eggs, two ounces compressed yeast, four pounds patent flour, two pounds raisins, one-half ounce spices. Bake in hot oven. When cold wash over with thin water icing.

Home-Made Raisin Bread

One pint water, one pint sweet milk, two ounces sugar, one ounce salt, two ounces lard, one and one-half ounces compressed yeast, two pounds seeded raisins, four pounds flour (white or whole wheat). Have milk and water warm. Dissolve yeast in water. Mix dough thoroughly. Let dough raise well, then punch down and let raise again. Mould in round loaves, and when raised bake in hot oven of about 450 degrees. When potato yeast is used, use one pint yeast and one pint milk or water.

Raisin Brown Bread

Three cups yellow corn meal, one and one-half cups graham flour, one and one-half cups white flour, one cup N. O. molasses, one teaspoon soda dissolved in one-half cup hot water, one teaspoon salt, enough sour milk to make soft batter. Mix flour and salt, then molasses with soda, stir until foamy, then add milk and one and one-half cups Sultana raisins. Fill mould half full and steam three hours.

Raisin Pie and Pudding

Mock Mince Pie—Cheap but Good

Two cups Sultana raisins (one pound), one-fourth cup vinegar (good), three-fourths cup boiling water, one cup sugar, one-fourth teaspoon cloves, one-half teaspoon cinnamon, one-fourth teaspoon allspice or nutmeg; little salt; chop or grind raisins, add three-fourths cup boiling water and cook 10 minutes. Mix the vinegar, boiling water, sugar, salt, spices, and boil until it becomes a syrup (eight or ten minutes). Combine the syrup and raisins and let cool slightly. Cover and bake.

Raisin Pie (Without Eggs)

Two cups raisins (Sultana or Thompsons preferred), small stick or one-half teaspoon cinnamon, one-half tablespoon butter, one-half cup sugar, tablespoon flour and pinch salt. Cover raisins with boiling water, add cinnamon and cook 20 minutes. Mix sugar, salt and flour and sprinkle one-half on lower pie crust; add raisins and sprinkle with other one half of sugar, etc. Add few dots of butter and upper crust and bake.

Rice Pudding

Boil rice until tender. One quart milk, three eggs beaten light, four tablespoons sugar, one teaspoon vanilla, one and one-half cups cooked rice, one cup seeded raisins. Put in dish, grate nutmeg over top and bake until brown.

Bread Pudding

Make custard of one quart milk, three eggs and four tablespoons sugar; add bread in small pieces and one cup raisins. Flavor with vanilla and nutmeg and bake.

RAISIN CAKES AND COOKIES

Splendid Raisin Cake

One-fourth cup butter or lard, one cup sugar, one-half cup milk, two and one-half teaspoons baking powder, two eggs, one-half teaspoon vanilla, one and three-fourths cups flour, one and one-fourth cups chopped raisins. Cream butter and add sugar gradually. Add beaten eggs and milk. Add the flour sifted with baking powder, vanilla and raisins. Bake in layer tins 20 to 30 minutes. Filling —Whip one and one-half cups heavy cream until stiff, add one-half teaspoon vanilla, two tablespoons powdered sugar, three and one-fourth cups chopped raisins (finely chopped).

Potato Cake With Raisins

One cup butter, two cups sugar, two cups flour, one cup mashed potatoes, one-half cup milk, one cup chopped walnuts, one cup seeded raisins, one cup chocolate, four eggs, one-third teaspoon cinnamon, one-third teaspoon cloves, one-third teaspoon nutmeg, two teaspoons baking powder. Spread dough in bread pan and bake in medium hot oven.

Raisin Nut Cake

Six eggs, two teacups sugar, three and one-half cups flour, one cup butter, one and one-half cups sweet milk, one cup walnuts, two pounds raisins, one wine glass brandy, two teaspoons baking powder, spices to taste. Bake in moderate oven.

Fruit Cookies

One pound sugar, one pound dark brown sugar, one pound butter, one and one-half pounds raisins, two and one-half pounds flour, one-half cup molasses, eight eggs, cinnamon and cloves to taste, one teaspoon soda dissolved in a little hot water. Cream butter and sugar as for regular cake and mix accordingly. Drop a tablespoonful on a buttered pan and it should spread like a cookie. If too thin a little more flour may be added. This is a very large amount.

Oatmeal and Raisin Gingerbread

Warm one pound of molasses with one-fourth pound of butter, lard or dripping and one-fourth pound of brown sugar. Mix with one and one-half pounds of fine oatmeal, one-half pound of flour, one teaspoonful of baking powder, one tablespoonful of ground ginger, one-half teaspoonful of mixed spice, one ounce of candied peel cut fine, and one pound of raisins chopped small. Pour the molasses, etc., over the dry ingredients and mix well. Pour into a buttered tin and bake. A portion of this mixture can be made into squares or nuts and baked in a slow oven. Eggs may be worked in as for ordinary cake if preferred. This is especially good and nourishing for children.

Raisin Candies

Raisin Fudge

Two cups sugar, one cup milk, butter size of an egg, one-half cup chocolate. Cook, stirring continually until bubbles break slowly. Have ready one-half pound walnuts chopped fine and one pound chopped seeded raisins. Add these and stir until stiff and pour into buttered pans; mark in squares when sufficiently cool.

Raisin Chocolates

Select smooth seeded raisins. Put one-half pound cake of vanilla sweet chocolate in a sauce pan over boiling water, and when melted add two level tablespoons butter and two of boiling water. Dip raisins and put on oiled paper.

Raisin Panoche (For Confectioners)

Five pounds maple or brown sugar, one and one-half pounds glucose cooked with quart of rich milk to medium ball. Grained off in kettle. Add three pounds of seeded raisins and one pound almonds or walnuts. Flavor with vanilla.

Italian Cream (For Confectioners)

Five pounds white sugar and one pound glucose cooked with one quart cream to medium ball. Grained off in kettle. Add three pounds seeded raisins and one pound walnuts. Flavor with vanilla.

Raisin Opera Caramels (For Confectioners)

Four pounds of sugar and three pounds of glucose cooked with one gallon rich cream to hard ball. Stir while cooking. Set off and add five pounds seeded raisins and few nuts if desired. Pour on slab and mark in caramel squares.

Miscellaneous Raisin Recipes

Raisin Sandwiches

Delicious for afternoon teas, picnics and children's lunches. Chop fine one cup of seeded raisins, together with one cup of nuts, preferably walnuts, mix with whipped cream or the white of an egg beaten, season with salt. Spread between slices of bread cut very thin.

With Mayonnaise

Chop fine one-half pound seeded raisins and one-fourth pound walnuts, to-

gether. Mix with a little mayonnaise dressing and spread between well-buttered pieces of steamed bread. The most delicious sandwich ever offered a child.

Delicious Raisin Ice Cream

Two cups (one pound) best seeded raisins finely ground, two cups sugar, four eggs, one pint rich cream, five pints fresh milk, one teaspoonful pineapple flavoring. Beat eggs well and add sugar and beat again; add cream and beat again. Thin raisins with milk and stir thoroughly in freezer. Makes one gallon of ice cream fit for a royal family.

There is no finer fruit ice than finely-ground seeded raisins added to ice cream of any flavor.

Raisin Salad

One cup celery cut in pieces, one-half cup of walnuts, cut in pieces, one-half cup chopped raisins. Combine and serve on lettuce leaves with mayonnaise dressing or cream dressing.

Stuffed Raisins for Lunches and Teas

Blanch almonds. Select large Muscat raisins and take out seeds. Slit raisins slightly and insert almonds and draw skin around to cover opening.

Comparative Food Values

One pound of raisins represents a food value equal to each of the following.

Six pounds of apples.

Five pounds of bananas.

Four and one-fourth pounds of potatoes.

One pound of bread.

Four pounds of milk.

Four and three-fourths pounds of fish (edible portion).

Two pounds of eggs.

One and one-third pounds of beef.

An important medicinal value of raisins is in their laxative effect.—U. S. Dept. of Agriculture Bulletin No. 142.

RASPBERRY

Raspberry Buns

Two and one-half teaspoons raspberry extract, four cupfuls flour, three-fourths cupful sugar, one-half cupful butter, two eggs, one-half cupful milk, two heaping teaspoonfuls baking powder, some raspberry jam, one-fourth teaspoonful salt.

Sift the flour, baking powder and salt into a basin. Then rub in the butter finely, and add the sugar. Beat up the eggs, stir in the milk and raspberry extract, add these to the other ingredients, mixing the whole to a stiff paste.

Divide the mixture into twelve or fifteen pieces, shape each into a ball, make a small hole in the middle, put just a little raspberry jam into it, then draw up the paste over the jam; put the buns, with the side which had the hole downwards, on a buttered baking tin, brush them over with a little beaten egg, and dust over with sugar. Bake in a hot oven for twenty minutes.

RASPBERRY JELLY. See *Canning and Preserving Fruits*, page 729. Also see *Barberry and Apple Jelly* under *Apple Recipes*, this section.

To Can Red Raspberries

Put the wash boiler on the stove, with small piece of lath or shingle in the bottom, fill jars with the berries, being careful not to crush them, set them in the boiler, being careful that the jars do not touch one another, and fill the boiler up to three inches of top of jars with cold water, let boil; in the meantime make a syrup of two cups water, one of sugar, have it boiling hot, and when the berries are at scalding (use a dairy thermometer to ascertain that, by running it down into the jars of berries), fill with the boiling syrup and screw on the tops, removing at once from the boiler. The berries will remain whole, have a beautiful color and delicious flavor.

Other fruits and berries may be canned in the same way as raspberries. The amount of sugar will of course vary somewhat with the different kinds of fruit, some requiring more sugar and some less than raspberries.

For other methods, see *Canning and Preserving Fruits*, page 725, and *Canning Fruit with Honey*, this section.

RHUBARB

Rhubarb Butter

Wash and chop fine the desired amount of rhubarb. To each pound allow one pint of sugar and just enough water to keep it from burning. Let it simmer very gently for an hour or even longer. The time depends entirely upon the age of the rhubarb. An asbestos mat should be kept under the preserving kettle and the rhubarb stirred frequently. This makes a delicious butter, which may be varied by adding half an orange pulp, when a delicious marmalade will be the result.

Pieplant Dumplings

Cut up and cook until tender one and one-half pounds of pie plant, sweetening it with a heaping cupful of sugar cooked in half a cupful of hot water. Cook seven minutes. Make a paste with half a cupful of flour, a scant half cupful of butter and a level teaspoonful of baking powder. Moisten just enough to hold together with cold water. Roll out and cut in four-inch rounds. Place two tablespoonfuls of stewed pieplant in the center of each round; gather up the edges into a ball, pinch the edges together, brush with milk, sprinkle with sugar and bake in a hot oven. Serve with a sauce made with the remainder of the pieplant, to which add a lump of butter the size of a walnut and a tablespoonful of cornstarch dissolved in cold water to thicken it. Boil up once and serve.

RHUBARB JELLY. See *Barberry and Apple Jelly* under *Apple Recipes*, this section.

STRAWBERRY

Hulling Strawberries

A pair of candy tongs is especially useful during the strawberry season. Holding a berry in the left hand, one can remove its hull more quickly and easily with these tongs than without them. They save staining the fingers too, and the accompanying accumulation of seeds under the nails.

Strawberry Cream Jelly

For a delicious strawberry cream jelly soak a package of gelatin in one cupful of water for one hour, then pour over it one pint of milk that has been scalded, with one-half cupful of granulated sugar, stir over the fire until thoroughly dissolved, strain into a bowl, and, when partially cooled, stir in one cupful of sweet cream that has been whipped to a froth. Have ready one quart of ripe strawberries, washed, hulled and crushed with one cupful of fine white sugar; beat them into the cooled gelatin mixture and add gradually the strained juice of a lemon. Turn the jelly into a mold that has been standing full of cold water and set on ice until firm. To serve, turn out carefully on a shallow dish and garnish with frosted strawberries rolled in granulated sugar.

Strawberry Ice Cream

A strawberry ice cream in which the actual fruit is used and not merely the flavoring extract, is quite ambrosial for a hot-weather dessert. For this sprinkle one and one-half cupfuls of granulated sugar over one quart of hulled strawberries and let it stand for an hour. Soak one tablespoonful of gelatin in just enough water to cover it for half an hour, then pour slowly over it one quart of thin cream that has been brought to a scald with half a cupful of white sugar. Stir until the gelatin is all dissolved, and when it is cool mix in the strawberries, which have been pressed through a fine sieve. Freeze and pack in ice and salt.

Strawberry Shortcake

One cup of sour cream, one teaspoonful of cream of tartar, two-thirds teaspoonful of soda, flour enough to make a suitable dough to roll out one-half inch thick, bake nicely, split open and spread each half with only the sweetest, freshest butter, then pour on one of the halves two whole cups of perfectly ripe, luscious strawberries, put on the other half for a cover, and pour over sweetened cream when eaten.

Strawberry Shrub

Over three quarts of hulled berries pour sufficient vinegar to just cover, let stand for two days, then drain off all the

liquid without pressing. Pour it over a second lot of berries, let stand as before and drain a second time, then measure. For one quart, take over half a cupful of water, add to it one tablespoonful of whole cloves and two tablespoonfuls of broken stick cinnamon and simmer gently for 15 minutes. Strain, pressing hard, add to the measured vinegar, and bring to a boiling point. Add two pounds of granulated sugar, boil 10 minutes longer and bottle. A few tablespoonfuls to a tumbler of water makes a delightful summer drink.

CANNED STRAWBERRIES. See *Raspberries*, this section.

STRAWBERRY JELLY. See *Barberry and Apple Jelly* under *Apple Recipes*, this section.

TAPIOCA

Fruit Tapioca

One cupful of pearl tapioca, strained juice of one lemon, strained juice of one and one-half oranges, one-half can of sliced pineapple, shredded, with its juice, one and one-fourth cupfuls of sugar, one cupful of water, whites of two eggs.

Soak the tapioca over night in cold water. In the morning drain off the water and place the tapioca in a double boiler with all the other ingredients except the whites of the eggs. Cook until clear. More than one cupful of water may be found necessary. When done pour into a large dish, then fold the whites of the eggs, stiffly beaten, into the hot tapioca. Serve cold with or without cream.

Tutti-Fruitti Filling for Cake

Stone and chop half a pound of raisins; cut one-fourth a pound of citron into thin slices and one-fourth a pound of figs into small pieces; blanch and slice one-fourth a pound of almonds and cut half a pound of crystallized fruits into small pieces; squeeze over these the juice of one lemon. Add one pound of confectioners' sugar (sifted) and enough boiling water to make a paste that will hold its shape.

CANNING FRUIT WITH HONEY

There is no mystery or luck about the successful canning of fruit. If properly done, failure is almost out of the question. The fruits or vegetables should be barely ripe, never overripe, perfect of their kind, or at least with no fermentation started in them, and the sooner they are taken from tree or garden and sealed up in jars the better. New fruit jars are best put over the fire in cold water to cover them, brought slowly to a boil, and slowly cooled; then they will stand greater extremes of heat and cold.

If particular about keeping the fruit in shape, or where a large amount is to be done at once, it is usually put uncooked into the jars and covered with the honey. The jars are then set into a large boiler with a perforated rest under them to keep them from the bottom. Fill the boiler with cold water nearly to the shoulders of the jars. Screw the tops on rather loosely; put the cover on the boiler and bring to a boil. Both fruit and vegetables can be done up in this way. As a rule, the latter is more difficult to keep than fruit, and require much longer cooking.

Twelve quarts of raspberries require two quarts of honey. Put two quarts of the fruit in the preserving kettle and heat slowly on the stove. Crush the berries with a wooden vegetable masher and spread a square of cheesecloth over a bowl and turn the crushed berries and juice into it. Press out the juice and turn it into the preserving kettle. Add two quarts of honey and put it on the stove. When the syrup begins to boil, add the remaining ten quarts of berries. Let them heat slowly. Boil ten minutes, counting from the time they begin to bubble. Skim well while boiling. Put in cans and seal.

Of cherries, take six quarts, one and one-half quarts of honey. Measure the cherries after the stones have been removed. Pit them or not, as you please. If you pit them, be careful to save all the juice. Put the honey in the preserving kettle over the fire until it simmers. Put in the cherries and heat slowly to the boiling point. Boil ten minutes, skimming carefully.

Of pears, plums and peaches, you take the weight of the fruit in honey. Plums should boil about fifteen minutes; peaches and pears from twenty to thirty.

Blackberries are put up same as raspberries.

Of strawberries, take four quarts of fruit and one and one-half quarts of honey. Boil ten minutes. From the time it begins to boil, skim well.

Of rhubarb, take equal weight of fruit and honey. Boil ten minutes.

Of apples, take two quarts of fruit and one pint of honey and a half pint of water. Boil twenty minutes.

Of corn, take two quarts, cut off the ear; half a pint of honey, one pint of water, four even teaspoonfuls of salt; boil twenty or thirty minutes, then put into jars or bottles.

Of tomatoes, take three quarts, one pint of honey, three tablespoonfuls of salt; boil the same as corn.

Of corn and tomatoes, take two quarts of corn, two quarts of tomatoes, one and a half pints of honey, half a pint of water, five even tablespoonfuls of salt; boil thirty minutes, then seal.

Grape, raspberry, blackberry, cherry, plum and peach juices are made as follows: One quart of juice, one pint of honey; boil from ten to twenty minutes.

COMBINING FRUITS

Many fruits can be bettered by judicious use of other fruits. Blackberries and blueberries make a better pie than single, using blueberries in large quantity.

Combine quinces with apples.

Tomato preserves are improved with sliced orange or lemon.

Jelly of apples and pears have pear flavor and apple firmness. Strawberries and gooseberries make better jam. To five quarts strawberries add two of gooseberries, either green or turning red.

Gooseberries, currants and raspberries in equal parts make good jam.

Elderberries, with green grapes, gooseberries or crabapples for jelly, sauce or pie.

For roly poly or jam, black currants and red currants.

Ripe red currants and ripe gooseberries make good preserves or pies.

Black raspberries stewed with red, juicy cherries.

Peach jam and grated pineapple is pleasant.

Blackberries are improved with a cupful of currant juice to each jar of fruit.

Evaporated peaches and apricots are better than alone.

NATURAL FRUIT JAMS

Such fruit as red and black raspberries and strawberries make the most delicious uncooked jam and one can enjoy a very palatable shortcake in the middle of the winter at very small expense. To prepare this jam, be sure first that your berries are sound. Throw out all soft, mouldy or in any way decayed fruit. This is imperative. Then mix equal amounts of sugar and fruit, and crush the whole mixture carefully. Be sure that no berries are left whole.

Before putting into the jars some people stir the fruit occasionally for several days to be sure that the sugar and fruit become thoroughly mixed. After the fruit and sugar are so mixed, put them into fruit jars but do not seal them. The only covering that should be given them is a little paper to keep out dust. If the jars are sealed, the chances are that the fruit will spoil, but if left unsealed, it can be kept for some time. I have kept it for two years.

Red and white currants treated this way make a delicious jam. This is somewhat different from that known as sun-dried jam. The sun-dried jam is cooked somewhat. In the natural jam the flavor of the fruit is preserved.

C. I. Lewis,
Corvallis, Ore.

VEGETABLES

For methods of canning vegetables, see *Canning Vegetables in the Home*, page 732.

Artichokes

Globe Artichoke

The large flower bud of the *Cynara scolymus* is known as the globe or French

artichoke. The flower buds must be used before they open. The edible portion consists of the thickened portion at the base of the scales and the receptacles to which the leaf-like scales are attached. In cookery books the receptacles are always spoken of as the bottoms. The parts of the flower in the center of the bud are called the "choke" and must always be removed.

When the artichoke is very young and tender the edible parts may be eaten raw as a salad. When it becomes hard, as it does very quickly, it must be cooked. When boiled it may be eaten as a salad or with a sauce. The scales are pulled with the fingers from the cooked head, the base of each leaf dipped in the sauce and then eaten. The bottoms (receptacles), which many consider the most delicious part of the artichoke, may be cut up and served as a salad, or they may be stewed and served with a sauce. To prepare the artichoke remove all the hard outer leaves. Cut off the stem close to the leaves. Cut off the top of the bud. Drop the artichokes into boiling water and cook until tender, which will take from 20 to 50 minutes, then take up and remove the choke. Serve a dish of French salad dressing with the artichokes, which may be eaten either hot or cold. Melted butter also makes a delicious sauce for the artichokes if they are eaten hot.

Jerusalem Artichoke

This tuber is in season in the fall and spring, and may be cooked like kohlrabi and served in a white cream or sauce. The artichoke may also be cooked in milk.

When this is done, cut the washed and peeled artichoke into cubes, put in a stewpan, and cover with milk (a generous pint to a quart of cubes). Add one small onion and cook twenty minutes. Beat together one tablespoonful of butter and one level tablespoonful of flour, and stir this into the boiling milk. Then season with a teaspoonful of salt and one-fourth of a teaspoonful of pepper, and continue the cooking half an hour longer. The cooking should be done in a double boiler. The artichoke also makes a very good soup.

ASPARAGUS

This delicious spring vegetable should be treated very simply, yet carefully.

Cut off the woody part, scrape the lower part of the stalk. Wash well and tie in bunches. Put into a deep stewpan, with the cut end resting on the bottom of the stewpan. Pour in boiling water to come up to the tender heads, but not to cover them. Add a teaspoonful of salt for each quart of water. Place where the water will boil. Cook until tender, having the cover partially off the stewpan. This will be 15 to 30 minutes, depending upon the freshness and tenderness of the vegetable. Have some slices of well-toasted bread on a platter. Butter them slightly. Arrange the cooked asparagus on the toast, season with butter and a little salt and serve at once. Save the water in which the asparagus was boiled to use in making vegetable soup.

Another method of cooking asparagus is to cut all the tender part into short pieces. Add boiling water enough to just cover the vegetable and place where the water will boil. Cook until tender (about fifteen minutes), season with salt and butter, and serve in the greater part of the juice.

If preferred, a cream dressing may be served with asparagus.

BEANS

To Blanch Green Beans

Green beans should always be blanched. To do this drain them from the cold water and put them into water that is boiling rapidly, allowing a teaspoonful of salt to two quarts of water. Boil rapidly, with the cover partially off the saucepan, for twenty minutes. Turn into a colander and let cold water run upon them. They are now ready to be finished in any manner you like. The blanching can be done in the morning while the fire is good and the beans be finished for dinner at the proper time.

Green Beans, Plain

One quart beans, one-half pint water,

one generous tablespoonful butter, one level teaspoonful salt.

String the beans if necessary and cut into two-inch lengths. Blanch them as directed. Drain and put in the saucepan with the water, salt, and butter. Cook for ten minutes over a hot fire, turning the contents of the saucepan from time to time. Serve very hot. If the beans are not tender it may take fifteen minutes to cook them, but under all circumstances be careful not to overcook, as this ruins the flavor. If overcooked, green beans become yellow or brown.

Stewed Shelled Beans

One quart shelled beans, one-fourth pound salt pork, one onion, one-half teaspoonful pepper, one tablespoonful flour, one quart boiling water, salt to taste.

Cut the pork in slices and fry it slowly ten minutes in a stewpan. Add the onion, cut fine, and cook twenty minutes very slowly. Cover the beans with boiling water and boil ten minutes. Drain off the water. Put the beans and flour in the stewpan with the pork and onion, and stir over the fire for five minutes. Add the quart of boiling water and the pepper. Place the saucepan where its contents will simmer for two hours. Taste to see if salt enough; if not, add salt.

This method of cooking new shelled beans gives a savory and substantial dish.

Green Lima Beans

Cover one quart of the shelled beans with boiling water. Place on the fire where they will boil up quickly, then draw back where they will just simmer until done. When tender pour off a part of the water. Season the beans with a teaspoonful of salt and two heaping tablespoonsfuls of butter.

Or drain the water from the beans. Put the butter in a saucepan with one tablespoonful of flour. Stir over the fire until smooth and frothy, then add the beans and stir over the fire for five minutes. Draw back and add half a pint of water, meat stock, or milk. Simmer ten minutes. If liked, a tespoonful of fine herbs may be added a few minutes before serving. It will take from forty-five to sixty minutes to boil the beans sufficiently.

Dried Beans

All dried beans require the same preliminary treatment, no matter how they are to be finally cooked and served. Look them over carefully to remove all dirt and pebbles, then wash clean. Soak them overnight in plenty of cold water. In the morning pour off the water and put them in a stewpan with cold water enough to cover them generously. Let them come to the boiling point in this water, then drain. If the beans are old and hard, for each quart put a piece of soda about the size of a large bean in the water in which they are soaked overnight, also in the first water in which they are boiled.

The scalded and drained beans should be put back in the stewpan and covered generously with boiling water. Add one tablespoonful of salt for one quart of beans. They should now cook slowly, with the cover partially off the stewpan until they have reached the required degree of tenderness. For stewed and baked beans the cooking must stop when the skins begin to crack. For beans served with a sauce they should cook until perfectly tender, but they must not be broken or mushy. For puree and soups they should be cooked until very soft.

Puree of Dried Beans

Cook one quart of beans in water until very soft, then drain well (saving the water) and rub through a puree sieve. Put one pint of the strained beans in a stewpan with two tablespoonfuls of butter or savory drippings, one teaspoonful of sugar, one teaspoonful of salt, one-fourth of a teaspoonful of pepper, and hot milk enough to make the puree like thick mush. About half a pint of milk will be right. Cook in the double boiler for one hour, stirring often and adding more milk if too dry. Heap the puree in the center of a hot platter. Garnish with a circle of fried sausages, pork chops, mutton chops, or any fat meat. The puree may be served as a vegetable, with any kind of meat. A soup may be made with

the water in which the beans were cooked and the remainder of the strained beans.

Dried Beans Saute

Cook the beans until tender, but not broken. Drain off the water and save it for soup. For one quart of beans put three tablespoonfuls of savory drippings or butter in a large-bottomed stewpan. When the fat is hot put in the drained beans, which have been seasoned with a tablespoonful of salt and half a teaspoonful of pepper. Cook over a hot fire for fifteen minutes, frequently turning the beans over with a fork. Cover and let them cook for half an hour where they will not burn. If the beans are liked moist add a cupful of meat broth, milk, or water before putting them to cook for the last half hour.

This dish may be made more savory by frying a tablespoonful of minced chives, shallot, or onion in the butter or fat before adding the beans. A tablespoonful of fine herbs may also be added to the beans to make them more savory.

Dried Beans in Salad

Season the cooked and drained beans with any of the salad dressings described under salads, and serve as a salad.

Baked Beans

Cook the dried beans gently until the skins begin to break, then drain off the water. Put a layer of beans in a bean pot or deep earthen dish, and on this layer, in the center of the dish, place a piece of salt pork ("streak of fat and streak of lean"), having the rind side up, using for one quart of beans a half pound of pork; the rind should be scored. Fill up the dish with the beans, and add seasoning and water to cover the beans. The simplest seasoning is one tablespoonful of salt and half a teaspoonful of pepper to a quart of beans. Mix the salt and pepper with the water. If liked, a tablespoonful of mustard may be added as well as a tablespoonful or more of molasses and an onion. Instead of the pork a piece of salt or fat beef or mutton may be employed. In this case there should be from one and one-half to two pounds of the meat per quart of beans. If fresh meat be used, add more salt to the beans. If, on the other hand, salt meat is used, probably one teaspoonful of salt will be enough.

When mutton is employed trim off every particle of the skin.

Bake the beans in a very moderate oven for eight or ten hours. Add a little boiling water from time to time, but never enough to bring the water beyond the top of the beans. Any kind of bean may be baked in this manner. However, the small pea bean is the best for "Boston baked beans." The Lima and large white beans are best for the deep earthen dish. Do not cover the beans while baking.

Lentils

Lentils may be cooked in puree, soups, etc., like dried beans.

BEETS

Beets are among our most useful vegetables, since they may be had all through the summer and may also be stored in good condition for winter use. Sometimes beets are cut in small pieces, after boiling, and served with white sauce, but the most common as well as the most palatable way of serving them is with butter.

Beets With Butter

Wash the beets, being careful not to break the skin. Put into a stewpan and cover generously with boiling water and boil until tender. Young beets will cook in one hour. As the beets grow old the time of cooking must be increased. In winter this vegetable becomes so hard it may require four or more hours of steady boiling to soften it. It is then only suitable for pickling in vinegar after being thoroughly boiled.

When the young beets are cooked take them from the boiling water and drop them into cold water. Rub off the skin. Cut the beets in thin slices and season with salt and butter. Serve at once.

Beet Greens

Beets are usually thickly sowed, and as the young beet plants begin to grow they must be thinned out. The young

plants pulled from the bed make delicious greens, particularly if the root has attained some little size. Unfortunately, of late years the leaves are attacked by insects; therefore, they must be examined leaf by leaf, and all which are infested rejected. Do not separate the roots from the leaves. Wash thoroughly in many waters. Put into a stewpan and cover generously with boiling water. Add a teaspoonful of salt for every two quarts of greens. Boil rapidly until tender. This will be about thirty minutes. Drain off the water, chop rather coarse, season with butter and salt.

The vegetable may be boiled with pork as directed for "*Cabbage and Pork.*"

BROCCOLI

This vegetable is a species of cauliflower, and can be cooked and served in the same manner.

BRUSSELS SPROUTS

Remove the wilted or yellow leaves from the little heads or "sprouts," cut the stock close to the head, and soak in salted cold water for an hour or more. Drain well and put into plenty of boiling water. Allow one teaspoonful of salt to two quarts of water. Boil rapidly for 15 or 20 minutes, the time depending on the size of the heads. When done turn into a colander and pour cold water over the heads. They are now ready to cook in butter, or to serve with any kind of sauce. Or the boiling water may be drained from the sprouts, which can then be seasoned with butter, salt and pepper.

Brussels Sprouts Saute

One quart Brussels sprouts, three tablespoonfuls butter, one-half teaspoonful salt, one-fourth teaspoonful pepper.

To sauter a food is to cook it quickly in a frying pan in a little fat. Blanch the sprouts and drain well. Put them into a broad-bottomed saucepan with the butter and other seasonings. Place over a hot fire and shake frequently. Cook five minutes. Serve hot.

CABBAGE

To Boil Cabbage

Cut a small head of cabbage into four parts, cutting down through the stock. Soak for half an hour in a pan of cold water to which has been added a tablespoonful of salt; this is to draw out any insects that may be hidden in the leaves. Take from the water and cut into slices. Have a large stewpan half full of boiling water; put in the cabbage, pushing it under the water with a spoon. Add one tablespoonful of salt and cook from 25 to 45 minutes, depending upon the age of the cabbage. Turn into a colander and drain for about two minutes. Put in a chopping bowl and mince. Season with butter, pepper and more salt if it requires it. Allow a tablespoonful of butter to a generous pint of the cooked vegetable. Cabbage cooked in this manner will be of delicate flavor and may be generally eaten without distress. Have the kitchen windows open at the top while the cabbage is boiling and there will be little if any odor of cabbage in the house.

Cabbage Cooked With Pork

For a small head of cabbage use about half a pound of mixed salt pork. Boil the pork gently for three or four hours. Prepare the cabbage as for plain boiled cabbage. Drain well and put on to boil with the pork. Boil rapidly for 25 to 45 minutes. Serve the pork with the cabbage. The vegetable may require a little more salt.

Smoked bacon or ham may be substituted for the pork. Cabbage may be cooked in water in which corned beef was boiled.

Cabbage With Sausage

Six sausages, one quart minced cabbage, one-half teaspoonful pepper, salt, if necessary.

Fry the sausages crisp and brown. Take from the frying pan and pour off all but three tablespoonfuls of the fat. Put the minced cabbage in the frying pan and cook six minutes. Arrange in a hot dish and garnish with the sausages. Serve mashed potatoes with this dish.

CARROTS

Carrots With White Sauce

Scrape the carrots lightly; then cut into large dice or slices. Put into a

stewpan with salted boiling water, allowing a teaspoonful of salt for a quart of water and boil until tender. The young carrots will cook in 30 minutes and the old ones in 45. Drain, season with a little salt, put them in a vegetable dish and pour the white sauce over them. Or the carrots may be cut into dice before cooking and boiled and drained as directed; then put them back in the stewpan, and for every pint add one tablespoonful of butter, one teaspoonful of sugar, half a teaspoonful of salt and one gill of water or meat stock. Cook over a hot fire until the carrots have absorbed the seasonings and liquid.

Carrots a la Poulette

Wash and scrape carrots and cut in small cubes; there should be two cupfuls. Remember that the best flavor, as well as the brightest color, lies nearest the skin, for which reason they should never be pared. Cover with boiling water and let stand five minutes. Drain and cook in boiling salted water, to cover, until soft. Melt three tablespoonfuls of butter, add three tablespoonfuls of flour and stir until well blended; then pour on gradually, while stirring constantly, one cupful of chicken stock (the liquor in which a fowl has been cooked) and one-half cupful of rich milk, or cream. Bring to the boiling point and add carrot cubes and one-half teaspoonful of lemon juice and season with salt and pepper. As soon as thoroughly heated, add the yolks of two eggs, slightly beaten. Turn into a hot vegetable dish, garnish with a sprig of parsley and serve at once.

CAULIFLOWER

This vegetable, which a few years ago was a luxury, is now cultivated by nearly all market gardeners, and is within the means of all housekeepers. It is a most delicious vegetable when properly cooked, and vile when improperly cooked, which generally means when overcooked.

Remove all the large green leaves and the greater part of the stalk. Put the head down in a pan of cold water which contains to each quart a teaspoonful of salt and a teaspoonful of vinegar. Let it soak in this water an hour or more. This is to draw out worms, if any should be hidden in the vegetable. When ready to cook the cauliflower put it into a large stewpan, stem end down, and cover generously with boiling water. Add a tablespoonful of salt and cook with the cover of the saucepan partially off, boiling gently all the time. A large, compact head will require a full half hour, small heads from 20 to 25 minutes. If the flowers are loose the heat penetrates to all parts quickly. When compact a little extra time should be allowed for the cooking, but the time must never exceed the half hour. The cauliflower begins to deteriorate the moment it begins to be overcooked. Overcooking, which is very common, can be told by the strong flavor and dark color. It makes the vegetable not only unpleasant to the eye and palate, but indigestible also. If this vegetable must be kept warm for any length of time, cover the dish with a piece of cheesecloth. In hotels and restaurants it is better to blanch it, chill with cold water and then heat in salted boiling water when needed.

Creamed Cauliflower

One pint cooked cauliflower, one pint milk, one teaspoonful salt, one-third teaspoonful pepper, one tablespoonful butter, one-half tablespoonful flour, three slices toasted bread.

Have the cooked cauliflower broken into branches and seasoned with half the salt and pepper. Put the butter in a saucepan and on the fire. When hot add the flour and stir until smooth and frothy, then gradually add the milk, stirring all the time. When the sauce boils add the salt, pepper and the cauliflower. Cook 10 minutes and dish on the slices of toast. Serve very hot.

CELERIAC

This vegetable is also known as "knot celery" and "turnip-rooted celery." The roots, which are about the size of a white turnip, and not the stalks, are eaten. They are more often used as a vegetable than as a salad.

Pare the celeriac, cut in thin, narrow

slices and put into cold water. Drain from this water and drop into boiling water and boil 30 minutes. Drain and rinse with cold water. The celeriac is now ready to be prepared and served the same as celery.

CELERY

Only the tender, inner stalks should be eaten raw. The hard, outside stalks make a delicious and wholesome dish when properly cooked. When thus used, celery should be blanched and served with a sauce.

Stewed Celery

To blanch celery in cooking, remove all the leaves from the stalks. Scrape off all rusted or dark spots, cut into pieces about three inches long and put in cold water. Have a stewpan of boiling water on the fire, wash and drain the celery and put in the boiling water. Add one teaspoonful of salt for every two quarts of water. Boil rapidly for 15 minutes, having the cover partially off the stewpan. Pour off the water and rinse with cold water, then drain. The celery is now ready to finish in the following manner: Put the celery in the stewpan with one tablespoonful of butter, and one teaspoonful of salt for each quart of celery. Cover and cook slowly for 15 minutes. Shake the pan frequently while the celery is cooking. Serve hot.

GREEN CORN

Boiled Corn on the Cob

The most satisfactory way to serve green corn is on the cob. Free the corn from husks and "silk." Have a kettle of water boiling hard, drop the corn into the water and cook 10 minutes. If only a few ears of corn are put in a kettle of boiling water, the temperature of the water is not lowered greatly and the corn will cook in eight minutes. On the other hand, if a large quantity of corn is crowded into a kettle of boiling water, the temperature is very much lowered and the time of cooking must be increased. When possible, surround the corn with a generous quantity of boiling water.

Corn Cut from Cob

Corn may be cut from the cob and heated with butter, pepper and a little milk. For this dish cook the ears five minutes in boiling water to set the juice. Then with a sharp knife cut through the center of each row of grains and with the back of a case knife press the grains of corn from the hulls. Put the corn in a saucepan and season with salt, pepper and butter. Add enough hot milk to moisten well and cook 10 minutes. Serve at once.

The raw corn may be cut from the cob and treated in the same manner.

Corn Oysters

Grate raw corn from cobs. To one cupful of pulp add one egg well beaten and one-fourth cupful of flour. Season highly with salt and pepper. Drop by spoonfuls on a hot, well-greased griddle. Saute until browned on one side, turn and brown other side. Try these, when your corn is not as sweet as you wish it to be to eat from the cob.

Succotash

To a pint of corn cooked as above add a pint of cooked and seasoned shelled beans.

CUCUMBERS

The cucumber is much oftener eaten in the United States as a salad than cooked, yet it is a very palatable vegetable when stewed and served with a white sauce or seasoned with butter, salt and pepper and served on toast. The pared and quartered cucumber should be cooked until tender in boiling salted water, which will require about 15 minutes, and then served as directed. Cucumbers may also be cut in slices lengthwise and fried like summer squash or eggplant.

Stewed Cucumbers

Stew pared cucumbers, cut in quarters or in thick slices, for 15 minutes in a saucepan with a little water and a minced shallot or a small minced onion. Pour off the water; stir in a little flour, butter and salt; heat for two or three minutes and then serve.

Cucumber Saute

Boil pared and quartered cucumbers for three minutes only. Then drain the pieces and season with salt and pepper. Roll in flour and cook in a saucepan with butter for 20 minutes. This dish may be varied by adding minced parsley, chives and chervil about five minutes before the cooking is finished.

Stuffed Cucumber Cups

Stuffed cucumber cups make a tasty entree which is something of a novelty. Pare cucumbers, cut in two-inch pieces, crosswise, and remove seeds. Place cups thus made in pan and fill with the following mixture: To four tablespoonfuls of soft, stale bread crumbs add two tablespoonfuls of finely chopped, cooked ham, two tablespoonfuls of grated Parmesan cheese. Season with salt, pepper and cayenne and moisten with tomato sauce. Surround cups with chicken stock and bake in a moderate oven 30 minutes. Remove to buttered pan, cover with buttered crumbs and bake until crumbs are brown.

EGGPLANT

This vegetable, as well as potato and tomato, belongs to the nightshade family. Like all succulent green vegetables, it has little nutritive value. The common methods of cooking are by frying, broiling and baking.

Baked Eggplant

For baked eggplant make a dressing as for stuffed peppers, except that a little more salt, pepper and butter are used. Cut the eggplant in two lengthwise, scrape out the inside and mash it fine, then mix with the dressing and return to the shells. Place on a pan and in the oven. Cook 45 minutes.

Fried Eggplant

For fried eggplant cut the vegetable in slices about half an inch thick and pare. Sprinkle the slices with salt and pile them upon one another, put a plate with a weight on top of the slices. Let them rest for an hour, then remove weight and plate. Add one tablespoonful of water, half a tablespoonful of salt and half a teaspoonful of pepper to an egg. Beat well. Dip the slices of eggplant in the egg, then in dried bread crumbs. Spread on a dish for 20 or more minutes. Fry till brown (in deep fat).

Broiled Eggplant

The eggplant is sliced and drained as directed above. Then spread the slices on a dish, season with pepper and baste with salad oil, sprinkle with dried bread crumbs and broil.

KALE, OR BORECOLE

There are several varieties of this vegetable. The dwarf, green-curled kale is the best for the table and is a fall and spring vegetable. The leaves are sweeter and more tender after having been touched by the frost. In the North the roots may be banked with earth at the beginning of winter and when extreme cold weather sets in the plants may be covered lightly with hay or straw. In the spring the old stalks will produce young shoots that make delicious greens.

Kale Boiled With Pork

Cook the kale the same as cabbage with pork.

Minced Kale

Remove all the old or tough leaves. Wash the kale thoroughly and drain, then put on to cook in a kettle of boiling water, to which has been added salt in the proportion of one tablespoonful to four quarts of water. Boil rapidly, with the cover off the kettle, until the vegetable is tender. Pour off the water and chop the kale rather fine; then put back into the kettle and add one tablespoonful of butter and two of meat broth or water for each pint of the minced vegetable. Add more salt if required. Cook for 10 minutes and serve at once. The time required for cooking kale varies from 30 to 50 minutes. If young and fresh from the garden it will cook in 30 minutes.

Sea Kale

This is a delicious spring vegetable. It requires practically the same culture as asparagus, and the young shoots are cooked in the same way as this vegetable. Sea kale may be cut the third

year from the planting of the seed. Cutting should not be continued after the flower heads begin to form. The flower heads may be cooked the same as broccoli.

KOHLRABI, OR TURNIP CABBAGE

Wash and pare the vegetables, then cut in thin slices. Put into slightly salted boiling water and boil, with the cover partially off the stewpan, until the vegetable is tender. This will take from 30 to 50 minutes. Pour off the water and season with butter, salt and pepper.

Kohlrabi may be boiled with pork in the same way as cabbage. The cold boiled vegetable may be served as a salad.

OKRA

Though okra, a variety of Hibiscus with mucilaginous edible pods, will grow in most parts of the United States, it is much more commonly eaten in the Southern states than elsewhere. The young pods should be boiled in salted water until tender (about 20 minutes), drained and heated for five minutes with cream (a scant cup to a quart of okra), a tablespoonful of butter and salt and pepper. Okra is also a common ingredient of soups.

ONION

Boiled Onions in White Sauce

Peel the onions and cut off the roots, dropping into cold water as fast as they are peeled. Drain from the cold water and put in a stewpan with boiling water to cover generously. Add a teaspoonful of salt for each quart of water. Boil rapidly for 10 minutes, with the cover partially off the saucepan. Drain off the water and cover the onion with hot sweet milk (a quart of onions will require a pint of milk). Simmer for half an hour. Beat together one tablespoonful of butter and one level tablespoonful of flour. Add one teaspoonful of salt and one-fourth of a teaspoonful of white pepper. Gradually beat in about half a cupful of the milk in which the onions are cooking. When smooth, stir the mixture into the onions and milk. Let the dish cook 10 minutes longer and serve.

Stewed Onions

Cut the onions in slices and boil in salted water for 10 minutes. Drain well and return to the stewpan.

For a quart and a half of onion, measured before it is boiled, add two tablespoonfuls of butter, one teaspoonful of salt and one-fourth of a teaspoonful of pepper. Cover the stewpan and cook over a hot fire for five minutes, shaking the pan to prevent the onion from browning. Set the stewpan back where the contents will cook slowly for 40 minutes. Drippings may be substituted for the butter, but, of course, the dish will not be so delicate in flavor.

Broiled Onions

For this dish a broiler, in which the wires run both ways, is needed, otherwise the onions persist in dropping into the fire. Put onions in cold water and remove skins while under water, then there is no trouble with one's eyes "watering." Cut in one-fourth-inch slices, arrange in a broiler, brushed over with butter. Set over dripping pan and bake until onions are soft; then broil over a clear fire to brown on one side, then turn and brown other side. Spread with butter and sprinkle with salt and pepper. These make a very attractive garnish for broiled beefsteak.

Baked Onions

Peel six onions and place in a baking dish with two tablespoons of butter, salt, pepper and half a cup of water. Bake in a moderate oven until tender, basting occasionally with the butter and water in bottom of the dish.

PARSNIPS

This vegetable, because of its pronounced taste, is probably not so generally liked as are most of the other roots. It is at its best in the early spring, when it has been in the ground all winter.

The simplest method of cooking the parsnip is to wash it clean, boil it and then scrape off the skin. Now cut in slices and put in the vegetable dish. Season with salt and butter. When the

parsnips are tender and just out of the ground they will cook in 35 minutes; when old it takes from 40 to 50 minutes to cook them. The cooked and peeled parsnips may be chopped rather coarse, seasoned with salt and put into a stewpan with hot milk enough to cover them. Place the stewpan on the range where the heat is moderate.

For a pint and a half of parsnips beat together one tablespoonful of butter and one teaspoonful of flour. Stir into the parsnips and milk. Simmer for 10 minutes. Parsnips are often cut in slices after boiling and fried in butter.

GREEN PEAS

This vegetable should be gathered when the seeds are about half grown, and it should be cooked as soon as possible after gathering. When the peas are thus young and tender they are best simply boiled and seasoned with salt and good butter. Some varieties of peas lack sweetness, and in this case a little sugar in the water in which they are cooked improves the flavor. Overcooking spoils the color and flavor of the vegetable. Peas should always be boiled slowly and with the cover partially off the stewpan. It is impossible to give the exact time of cooking this vegetable, since so much depends upon the maturity of the peas, the length of time they have been picked, etc. Young, tender peas will generally cook in 20 or 30 minutes, and the seasoning should be added while they are still firm and crisp. If the peas are cooked until the green color of the chlorophyll is destroyed they are overdone and their delicate flavor is spoiled. When peas are overgrown and a little hard they should be cooked by the rule "Peas with pork." When this rule is followed a pinch of delicate, small, white onions may be added to the peas and other ingredients and will give a very savory dish. Peas that have lost much of their natural sweetness are improved by a bit of sugar.

Boiled Peas With Butter

Put one quart of shelled peas in a stewpan and add enough boiling water to cover them generously. Place over a hot fire and when they begin to boil draw back where the water will bubble gently. Until the peas are done cook with the cover partially off the stewpan. When the peas are tender add one teaspoonful of salt and three tablespoonfuls of good butter. Cook 10 minutes longer. If the peas are not the sweet kind add a teaspoonful of sugar with the salt and butter.

Peas With Pork

One quart peas, four ounces pork, one tablespoonful butter, one gill water (one-half cupful), two small white onions, one-eighth teaspoonful pepper.

Cut pork into small bits. Put butter into stewpan and on the fire. When the butter is melted add the pork and cook gently until a light brown, then add the water, peas, onion and pepper. This is a good way to cook peas when they are a little old and hard.

Peas With Lettuce

One quart peas, two tablespoonfuls butter, one head lettuce (the heart), one small onion, one teaspoonful sugar, one-half gill water.

Put all the ingredients into a stewpan, cover and place over the fire and cook for five minutes, tossing the vegetables several times. Now draw the pan back where the contents will simmer slowly for half an hour.

Sugar Peas

The green pods of the sugar pea may be prepared like string beans.

Gather the pods while the seeds are still very small. String them like beans and cut into two or three lengths. Cover with boiling water and boil gently until tender. If they are young and fresh they will cook in 25 or 30 minutes. Pour off some of the water, which will serve for soup. Season with salt and butter and serve at once. When the pods are fresh and tender they have an exquisite flavor. When the seeds have grown large and the pods become tough they may be shelled and cooked like any other variety of peas. The seeds of the sugar pea are tender and fine flavored.

GREEN PEPPERS

The sweet green pepper, though fairly common in our city markets, is not as widely known as a vegetable as it deserves. Sliced, it makes a very fine salad alone, or, more commonly, mixed with other salad plants like lettuce. Stuffed and baked peppers are very palatable.

Green Peppers Stuffed and Baked

Use only tender sweet peppers. For six medium-sized peppers make a dressing in the following manner: Soak, in cold water, enough stale bread to make one pint when the water is pressed out. Season this with two teaspoonfuls of salt, one tablespoonful of fine herbs, about one-fifth of a teaspoonful each of sweet basil and summer savory, and two tablespoonfuls of butter or savory drippings.

Cut off the stem end of the pepper and remove all the interior, being careful to take out every seed. Fill the peppers with the dressing. Place them on end in a shallow baking dish and pour around them a sauce prepared as follows:

Put into a saucepan and on the fire one tablespoonful of drippings. When hot, add one level tablespoonful of flour. Stir until smooth and brown, then add, gradually, three gills of meat stock or water. Season with one level teaspoonful of salt. Cook five minutes, then pour around the stuffed peppers. Put the dish in a moderately hot oven and bake the peppers one hour, basting often with the sauce in the dish. Peppers may also be filled with a well-seasoned dressing of chopped meat, made with or without the addition of bread crumbs or rice.

PICKLES

For sweet pickles, boil together two pounds brown sugar, two quarts cider vinegar, one teaspoon each of cinnamon, cloves, nutmeg, ginger, cayenne pepper and a tablespoon of whole mustard. Pour over cucumbers and seal.

For sour pickles, add a cup of grated horseradish to each gollon, then pour over clear hot vinegar and seal.

It is not generally known that green muskmelons can be put down in brine the same as cucumbers, then soaked and made into sweet pickles even more delightful in flavor than the best of other pickles, but such is the case.

Before putting in brine merely open and remove seeds; when freshened remove tough skins before pouring on the syrup. The late ones that refuse to ripen may be used.

Bean Pickles

Take tender string beans, string them, and boil or steam them whole in salted water until done tender. Then place in a jar, sprinkling each layer with a little red pepper, or cayenne, to season. Or mix some chopped green pepper with them, then cover with strong vinegar.

Pickled Cauliflower

Break the cauliflower in small clusters, plunge in boiling salted water for three minutes, drain, and cover with cold vinegar, let stand for two days, then pack into glass or stone jars. On third day boil vinegar, add red pepper to taste and pour over cauliflower, then seal.

Grandfather's Chopped Pickle

Use one dozen green tomatoes, three heads of celery, one head of cabbage, three green peppers (seeds removed), one-half dozen good-sized onions, two large cucumbers, one cup of nasturtium seeds. Chop all together and scald in a weak brine, drain, and scald in about a quart of vinegar and water. Drain this off, and pour over the pickle, hot, the following:

Two quarts of vinegar, one and one-half pounds of brown sugar, one-quarter of a pound of white mustard seed, one tablespoonful of cinnamon, one teaspoonful each of red pepper, ground mustard, clove and allspice. Put in a stone crock.

Ripe Cucumber Pickle

Take large thick ones, remove skins and seeds; cut into rings or pieces suitable for serving. Boil until clear but not too soft in water to which has been added vinegar to give sour taste. Put into colander and drain. It is really better to let them stand several hours, pouring off the water frequently. Many failures arise from the fact that this is not done. The water comes out into the syrup and consequently the pickles spoil. Or one can

cover with cold vinegar and let stand 24 hours. It's less work, but more expensive, as the vinegar can not be used again. To each quart of vinegar for the syrup use two pounds of sugar and one ounce of cassia buds or a little more of the stick cinnamon and a little salt, about one tablespoonful. Boil together for 20 minutes. If put into crocks keep closely covered.

Dill Pickles

Line bottom of a three-gallon crock with grape leaves, add double layer of washed cucumbers; cover these lightly with fresh dill, then layer of leaves, etc., till crock is nearly full. Boil one large cup of salt and 19 cups of water, adding one teaspoon of coriander seed; when cool pour over pickles. Place a plate on top and weight down. In a few hours the brine will cover contents of crock.

Mustard Pickles

One quart each of small whole cucumbers, green tomatoes, small onions, one large cauliflower or cabbage, four green peppers cut fine, two stalks celery cut fine.

Make brine of four quarts of water and one-half pint salt. Pour over the mixture of vegetables and soak over night. Next morning heat up just enough to scald and drain in colander. Then mix one-half cup flour, one tablespoon turmeric, six tablespoons mustard with two quarts cold vinegar and stir into a smooth paste. Add one cup sugar, two quarts vinegar and boil mixture until it thickens and is smooth, stirring all the time. Add vegetables and cook until well heated through.

This is delicious and equal in every way to the prepared mustard pickles found in the stores.

Pickled Onions

Make a brine, let it come to a boil and skim. Put in the small onions, let come to a boil, then stand on the back of the stove for 15 minutes. Boil together five minutes one quart of vinegar, one large red pepper, chopped, seeds as well as outside. Fill quart jars with warm onions, pour in vinegar to overflowing and seal. These will keep any length of time and will be ready for use in two weeks.

Piccalily

Two gallons cabbage, one gallon tomatoes, 12 large onions chopped, mixed and well drained. One and one-half pounds of brown sugar, quarter-pound mustard seed, one ounce each of celery seed, cloves, allspice and pepper, one gill of salt, one gallon of good vinegar. Boil all together slowly for 30 minutes. One ounce of tumeric may be added if one likes the flavor or yellow color.

Green Tomato Pickle

One peck of green tomatoes sliced the day before pickling and sprinkled through and through with a little salt.

In the morning drain off the liquor. One dozen onions sliced, six red peppers chopped coarsely. Put in a suitable keg layers of tomatoes, then onions. Between each sprinkle the peppers and one cup sugar, one tablespoon each of cloves and cinnamon, one of mustard, teaspoon of cloves. Pour over vinegar to cover and boil 30 minutes. This is excellent.

Watermelon Sweet Pickles

To each quart of best vinegar add three pounds of brown sugar, and mixed spices to taste. Tie the spice in a cloth and boil in the vinegar and sugar for five minutes. Pour it over the rind which has been peeled and cut in pieces of size and shape desired and let stand for 24 hours. Then boil all together until the rind is clear, remove the rind, place in jars, boil down the syrup, and pour it over the melon.

POTATOES

Boiled Potatoes

The method and time given for boiling potatoes are the same whether the potato be peeled, partially peeled, or left with the skin intact. If a dozen or two ordinary sized potatoes are put on the fire in a large stewpan and are covered generously with boiling water and a cover is immediately put on the stewpan, they will be cooked to the proper point in 30 minutes from the time the cover was put on the stewpan. Small potatoes will cook in two minutes less time, and very large

potatoes will require about 35 minutes cooking. If the potatoes are to be boiled in their skins, wash them until clean and then with a sharp knife cut a narrow band of the skin from the center of the potato. Cut a little bit of the skin from each end of the potato. If the potatoes are to be peeled, use a very sharp knife and remove the thinnest possible layer. The skins may be scraped off, if preferred, and there are special knives for this purpose. Let the potatoes boil 15 minutes, then add one tablespoonful of salt for every dozen potatoes. When the potatoes have been cooking 30 minutes, drain off every drop of water and let all the steam pass off. They are now ready to serve, though they will not be injured but in fact will be improved by being kept hot for an hour or more, if they are well ventilated in such a way that they dry rather than retain moisture.

When boiled or steamed potatoes must be kept warm for any length of time, place the stewpan on the range on a tripod or iron ring and cover the potatoes with one thickness of cheesecloth. This will protect them from the cold air and allow the moisture to pass off.

Steamed Potatoes

Steamed potatoes are prepared as for boiling, put in a closed vessel having a perforated bottom, which is then put over a kettle of boiling water. The water must be kept boiling hard every moment. They will require from 30 to 40 minutes to cook.

Baked Potatoes

Select potatoes having a smooth, unmarred surface. Wash perfectly clean and let them drain. Put them in an old baking pan kept for this purpose—do not crowd them—and put in a hot oven. If the oven is large and hot and the potatoes of medium size, 40 minutes will answer for the cooking. On the other hand, if the oven is filled with cold potatoes the temperature of the oven will be reduced quickly and it will require an hour to cook the potatoes. Baked potatoes should be served as soon as they are done. If they must be kept any time after the cooking is completed, break them in order that the moisture may escape. Keep them in a warm oven or covered with cheesecloth in a stewpan.

Escalloped Potatoes

This dish may be prepared by mixing a pint and a half of cold potatoes cut in cubes and seasoned with a teaspoonful of salt, one-fourth of a teaspoonful of pepper and a pint of cream sauce. Put the mixture in a shallow baking dish, cover with grated bread crumbs and dot with butter. Bake half an hour in a moderate oven.

Sweet Potatoes

Baked Sweet Potatoes

Wash the potatoes and bake the same as white potatoes. Small ones will bake in half an hour, while very large ones will require an hour or more. If the potatoes are liked very moist and sweet, bake from an hour to two hours, depending on size.

Browned Sweet Potatoes

Boil medium-sized sweet potatoes 45 minutes. Peel them and cut in halves lengthwise. Put them in a baking pan and baste with savory drippings and season with salt. Cook them in a hot oven for 20 minutes.

Candied Sweet Potatoes

Candied sweet potatoes are very popular on Southern tables and are extremely palatable when well prepared. Cut boiled sweet potatoes into long slices, place in an earthen dish, put lumps of butter on each slice and sprinkle with sugar. Some cooks add a little water also. Bake until the sugar and butter have candied and the potatoes are brown.

RICE

Wash one cupful of rice in several waters, rubbing the grains between the hands to remove all the dirt. Put the washed rice in a stewpan with two and one-half cupfuls of water and one teaspoonful of salt. Cover and place where the water will boil. Cook for 20 minutes, being careful not to let it burn. At the end of this time put the stewpan on a tripod or ring and cover the rice with

a fold of cheesecloth. Let it continue to cook in this manner an hour, then turn into a hot vegetable dish. The rice will be tender, dry, and sweet, and each grain will be separated. During the whole process of cooking the rice must not be stirred. If a tablespoonful of butter is cut up and sprinkled over the rice when it has cooked 20 minutes the dish will be very much improved.

SALSIFY

This vegetable is sometimes called oyster plant, because the flavor suggests that of the oyster, particularly when the boiled vegetable is sliced and fried in butter. Salsify is one of the roots that may be left in the ground over winter, thus making this vegetable available for the late summer, fall and spring.

To prevent this root from turning dark it must be dropped as soon as it is pared and cut into a mixture of flour and water made slightly acid with vinegar. For six good-sized roots mix together one tablespoonful of vinegar, two tablespoonfuls of flour, one teaspoonful of salt and three pints of water. Wash and scrape the roots, then cut into slices about three inches long. Drop into the prepared water. Place the stewpan on the fire and cook the salsify 30 minutes, counting from the time it begins to boil. Drain and serve in a white sauce. Or mix together one tablespoonful of butter, half a teaspoonful of salt, one teaspoonful of lemon juice, and one teaspoonful of minced parsley or chervil. Add this to the drained salsify and serve at once.

SALADS AND SALAD DRESSINGS

Lettuce Salad With French Dressing

Two heads lettuce, two or three sprays tarragon, six or eight branches chervil, one tablespoonful minced chives or cibol, if the flavor is liked, French dressing.

Remove all the green, tough leaves from the heads of lettuce. Break off the tender leaves one by one and rinse in cold water. Shake off the water and lay the leaves on a piece of cheesecloth and put the lettuce, wrapped lightly in the cheesecloth, on ice. At serving time, put the leaves in the salad bowl. Have the herbs torn into small bits and sprinkle over the lettuce. Sprinkle the dressing (a spoonful at a time) over the salad. Lift and turn the salad with the spoon and fork. Continue mixing in this manner until all the dressing has been used. The work must be done lightly and carefully that the lettuce shall not be crushed. Serve immediately.

This is the French salad that so many travelers remember with great pleasure. The secret of its exquisite quality is that the lettuce is crisp and tender, delicate flavoring herbs are added to it, the vinegar is never strong, the oil is good, and, finally, the dressing is added just before the salad is served. In the heat of the summer, when head lettuce is not plenty, the tender young plants may be used. The flavor of the salad may be varied by the addition of other green salads and herbs, such as chicory, sorrel, borage, burnet, etc. When fresh tarragon is not available, tarragon vinegar may be employed.

Lettuce Salad With Cream Dressing

One large solid head lettuce, one tablespoonful vinegar, one-half teaspoonful salt, one-quarter teaspoonful pepper, four tablespoonfuls thick, sweet cream.

Remove the outer leaves from the head of lettuce, leaving only the crisp, clean, bleached leaves. Break the leaves one by one from the head, and if perfectly clean do not wash them. If not clean, wash quickly in cold water and drain. Tear each leaf into three or four pieces; put the shredded lettuce into a large towel or napkin and place on the ice or in a cold cellar. At serving time put the lettuce in a salad bowl. Mix the salt, pepper and vinegar in the salad spoon and sprinkle over the lettuce; stir well, then add the cream, a spoonful at a time, and mix by tossing the lettuce lightly with the spoon and fork. Serve immediately.

Cabbage Salad

Either red or white cabbage may be used for salad, and must be firm, crisp and tender. Remove the outer leaves and cut the tender cabbage into fine shreds.

Wash well and let soak in cold water for half an hour. Drain and season with French dressing or cooked salad dressing. Serve at once.

Cucumber Salad

This vegetable should always be crisp and fresh when used. There is an old and widespread belief that cucumbers are more wholesome if the slices are soaked in cold water or in salted water before serving. Doubtless the distress which some persons experience after eating cucumbers is due to the fact that they are swallowed without proper mastication. It does not seem probable that there is any unwholesome property in this vegetable when we recall the extent to which it is eaten in some other countries and the good reputation which it bears there. In Persia the cucumber is most highly prized and is consumed in very large quantities. On account of its succulent character it is often used by travelers in place of water, as the water supply in many villages and towns is not above suspicion.

Cucumbers should be pared and sliced thin, and then may be dressed with oil and vinegar, like lettuce, or with a little vinegar, salt and pepper. Cucumbers are at their best for salads when fairly young, and should not be used after the seeds have become hard and tough, as most persons consider them objectionable. A pleasant variation in the appearance of the dish may be easily obtained by slicing rather small cucumbers lengthwise instead of across, as is the more common method.

Dressings or Sauces for Salads

French Dressing

One tablespoonful vinegar, four tablespoonfuls olive oil, one-quarter teaspoonful salt, one-eighth teaspoonful pepper.

Put the salt and pepper in the salad bowl, or in a small bowl if the sauce is to be served separately. Add a little oil and stir well, then gradually add the remainder of the oil, stirring all the while. Last of all stir in the vinegar, which should be diluted with water if very strong.

This sauce may be modified to suit different vegetables. As it is given it is right for lettuce, chicory, cooked asparagus, cauliflower, artichoke, etc.

Cream may be substituted for the oil, but the salad is not so rich.

Cooked Salad Dressing

Two eggs, one gill vinegar, two gills milk, one tablespoonful oil or butter, one teaspoonful salt, one teaspoonful mustard, one-quarter teaspoonful pepper.

Put the oil and dry ingredients into a bowl and mix well. Add the eggs and beat for five minutes, then add the vinegar and beat one minute. Now add the milk, place the bowl in a pan of boiling water, and cook until the sauce thickens like thin cream. It will take about ten minutes. Stir the sauce constantly while cooking. Cool and bottle what you do not require for immediate use. This sauce is good for nearly all kinds of cooked vegetables.

If butter is substituted for the oil, add it just before taking the sauce from the fire.

Sour Cream Dressing

One-half pint sour cream, two tablespoonfuls lemon juice, two tablespoonfuls vinegar, one scant tablespoonful sugar, one teaspoonful salt, one-quarter teaspoonful pepper, one teaspoonful or more mixed mustard.

Beat the cream with an egg beater until smooth, thick, and light. Mix the other ingredients together and gradually add to the cream, beating all the while.

This dressing may be modified to suit different vegetables. Having beaten sour cream for a foundation the seasoning may be anything desired, as, for example, the mustard and lemon may be omitted and the dressing be seasoned highly with any kind of catsup.

A sweet cream may be substituted for the sour; it should be quite thick.

Cream Salad Dressing

One cupful cream (sweet or sour), one-half cupful tomato catsup, two tablespoonfuls olive oil, two tablespoonfuls vinegar, two tablespoonfuls sugar, one teaspoonful salt.

Mix the oil, salt, sugar and vinegar together, then beat in the catsup and finally add the cream, beating it in gradually.

This dressing is very good for vegetables, or for fish salads.

SEASONINGS FOR SAUCES FOR VEGETABLES

Tarragon Vinegar

Strip about three ounces of leaves from the branches of tarragon; put into a quart fruit jar and fill with good vinegar. Close and let stand for about 20 days, then strain. The best vinegar to use for this purpose is white wine vinegar, but good cider vinegar will also answer. The best time to make tarragon vinegar is about the last of August, when the plants are large and vigorous. Tarragon vinegar may be used for salads and sharp sauces, when the fresh herb is not available.

Cream Sauce

One-half pint milk, one tablespoonful butter, one teaspoonful flour, one-half teaspoonful salt, one-quarter teaspoonful pepper.

Heat the milk over boiling water; beat the butter and flour to a cream and stir into the hot milk. Cook five minutes, then add salt and pepper, and use. This sauce is suitable for boiled cauliflower, potatoes, carrots, etc. It is also a good sauce for escalloped dishes. This sauce may be modified by the addition of flavoring herbs.

Cream Mustard Sauce

Make the cream sauce as directed above. Mix one tablespoonful of mustard with a teaspoonful of cold water and stir into the sauce about two minutes before serving. The quantity of mustard may be increased or diminished, as one may desire the flavor strong or mild.

White Sauce

This sauce is made like the cream sauce, except that half a pint of white-meat broth is substituted for the milk, and two tablespoonfuls of flour instead of one are used. The saucepan is put directly on the stove and the sauce is simmered 10 minutes. White sauce, like cream sauce, may be modified by the addition of other flavors.

Tomato Sauce

Cook one pint of peeled and cut tomatoes 10 minutes, then rub through a strainer. Beat in a saucepan until smooth and light one tablespoonful of flour and one generous tablespoonful of butter. Gradually beat the hot tomato into this. Add the salt and pepper and cook 10 minutes. This sauce may be served with macaroni, rice, etc., as well as with fish and meat. The flavor of the tomato sauce may be modified by the addition of onion, spice or herbs.

VEGETABLE SOUPS

Nearly every vegetable grown may be employed in the preparation of soups, either as the foundation for the soup or as a garnish to any kind of meat stock. A few types of vegetable soups are here given. Meat, meat broth or beef extract may be added to any of them if additional flavor is desired, but as they stand they are very satisfactory soups.

Mixed Vegetable Soup

Three quarts water, one quart shredded cabbage, one pint sliced potato, one-half pint minced carrot, one-half pint minced turnip, one-half pint minced onion, one leek, two tomatoes, two tablespoonfuls minced celery, two tablespoonfuls green pepper, two tablespoonfuls butter or drippings, three teaspoonfuls salt, one-half teaspoonful pepper.

Have the water boiling hard in a stewpan and add all the vegetables except the potatoes and tomatoes. Boil rapidly for 10 minutes, then draw back where it will boil gently for one hour. At the end of this time add the other ingredients and cook one hour longer. Have the cover partially off the stewpan during the entire cooking. This soup may be varied by using different kinds of vegetables.

Herb Soup

One-half pint finely shredded spinach, one-fourth pint shredded sorrel, one-fourth blanched and sliced leek, the white heart leaves of a head of lettuce, four potatoes (medium size), three level teaspoonfuls salt, four tablespoonfuls butter, one tablespoonful chevril, two quarts boiling water, one-half pint bread cut in

dice and fried in butter or browned in the oven.

Have the sorrel, spinach and lettuce fresh, tender and free from tough midribs. Wash and shred. Cut the washed leek into thin slices. Put in the stewpan with the butter and cook 15 minutes, being careful not to brown. Now add the potatoes, salt and boiling water. Place the stewpan where the contents will boil quickly, and when the soup begins to boil draw the stewpan back where the contents will boil gently for one hour. At the end of this time crush the potatoes with a fork, add the chevril and simmer five minutes longer. Turn into the soup tureen, add the crisped bread and serve.

If preferred the soup may be rubbed through a puree sieve, returned to the fire and when boiling hot be poured on the yolks of two eggs which have been beaten with two tablespoonfuls of milk.

This soup may be varied indefinitely. Any number of green vegetables can be employed in making it, care being taken to use only a small quantity of those of pronounced flavor.

Sorrel Soup

Three pints boiling water, three tablespoonfuls butter, one-third cup shredded sorrel, three tablespoonfuls milk, one teaspoonful salt, yolk two eggs, one-half cupful bread cut in dice and dried in the oven or fried in butter.

Tear the tender green parts from the midribs of the cultivated sorrel; wash in cold water and shred very fine. Put half the butter in a stewpan and add the shredded sorrel. Place on the fire and cook five minutes, stirring frequently. Now add the boiling water and salt and boil 10 minutes. Beat the yolks of the eggs well, then add the milk and pour into the soup tureen and add the remaining half of the butter cut into bits. Gradually pour the boiling-hot soup in the soup tureen, stirring all the while to combine the hot mixture with the egg yolk. Add the bread dice and serve.

Leek Soup

Three quarts boiling water, two cupfuls leeks (cut fine), four cupfuls potatoes (cut in dice), two tablespoonfuls butter or drippings, three teaspoonfuls salt, one-half teaspoonful pepper, four slices stale bread cut in small pieces, four tablespoonfuls minced onion.

Wash the leeks and cut off the roots. Cut the white part in thin slices. Pare the potatoes and cut in dice. Put them in a bowl of cold water. Put the butter, leeks and onion in the soup pot and on the fire. Cook 20 minutes slowly, stirring frequently, then add the hot water, potatoes and seasoning and cook at least half an hour longer. Serve very hot. If it is convenient and liked, cook with the leeks and butter the white stalks of four or five cibols, or one shallot may be cut fine and cooked with the leeks.

This is a delicious and wholesome soup and is even better reheated the second day than the first.

Cream of Leek Soup

Make this soup as directed for leek soup, using only three pints of water. When it is cooked, rub through a sieve, return to the soup pot and add one quart of hot milk. Beat with whisk until smooth. Half a cupful of the milk can be reserved cold and added to two well-beaten yolks of eggs. Stir this into the soup just as it is taken from the fire.

The yolks of the eggs make the soup very much richer.

Potato Soup

Eight medium-sized potatoes, one-half pint chopped celery, four tablespoonfuls minced onion, one tablespoonful butter, one tablespoonful flour, one and a half teaspoonfuls salt, one-half teaspoonful pepper, one teaspoonful minced chervil or parsley, one quart milk.

Pare the potatoes and put in a stewpan with the celery and onion. Cover with boiling water and put over a hot fire. Cook 30 minutes, counting from the time the pan is put over the fire. Reserve half a cupful of the milk cold and put the balance to heat in the double boiler. Mix the flour with the cold milk and stir into the boiling milk. When the potatoes, etc., have been cooking 30 minutes pour off the water, saving it to use

later. Mash and beat the vegetables until light and fine, then gradually beat in the water in which they were boiled, rub through the puree sieve and then put back on the fire. Add the salt and pepper. Beat with an egg whisk for three minutes, then gradually beat in the boiling milk. Add the butter and minced herbs and serve at once.

Cream of Celeriac Soup

One quart celeriac cut in cubes, one quart white stock, one pint cream, one-half pint canned peas, two tablespoonfuls butter, two tablespoonfuls salt, one-half tablespoonful pepper, yolks of two eggs

Cook celeriac. Gradually add the hot white stock, rub through a fine sieve, return to the fire and add a cupful of canned peas. Reserve one cupful of the cream cold and add the remainder to the soup. Beat the yolks of the eggs well and add the cold cream to them, then stir the mixture into the soup. Draw back from the fire and beat with the whisk for one minute, then serve at once.

Tomato Soup

One quart peeled and finely cut tomatoes, one quart cold water, one onion, one tablespoonful sugar, two teaspoonfuls salt, one-half teaspoonful pepper, two tablespoonfuls butter, four tablespoonfuls cornstarch, one tablespoonful flour.

Mix the cornstarch with the water and put into a stewpan with all the other ingredients, except the butter and flour, the onion being left whole. Stir frequently until the soup boils, then cook half an hour, counting from the time it begins to boil. At the end of this time beat the butter and flour together until light and smooth and stir into the soup. Cook 10 minutes longer, then take out the onion and serve the soup with toasted or fried bread. If a smooth soup is desired strain through a fine sieve. This is the simplest kind of tomato soup. It may be varied by the addition of rice, macaroni, beans, peas and other vegetables. Instead of the fried bread stale bread may be cut in small pieces and put in the bottom of the soup tureen.

Okra and Tomato Soup

One pint sliced okra, one and a half pints tomatoes pared and cut fine, two quarts water, three tablespoonfuls rice, three tablespoonfuls minced onion, one green pepper (seeds removed and pepper cut fine), three tablespoonfuls salt, one-fourth teaspoonful pepper.

Put all the ingredients into the soup pot and cook gently for two hours, then add two tablespoonfuls of butter or sweet drippings and serve. The bones from roast meat or boiled meat cooked with this soup add to the flavor.

Green Pea Soup

One quart shelled peas, three pints water, one quart milk, one onion, two tablespoonfuls butter, one tablespoonful flour, three level teaspoonfuls salt, one-half teaspoonful pepper.

Put the peas in a stewpan with the boiling water and onion and cook until tender, which will be about half an hour. Pour off the water, saving for use later. Mash the peas fine, then add the water in which they were boiled and rub through a puree sieve. Return to the saucepan, add flour and butter, beaten together and the salt and pepper. Now gradually add the milk, which must be boiling hot. Beat well and cook 10 minutes, stirring frequently.

Split Pea Soup

One pint split peas, four quarts water, one-half pound salt pork, one large onion, two tablespoonfuls celery, one tablespoonful flour, one tablespoonful butter, one teaspoonful pepper, one sprig parsley.

Pick the peas over, that there may be no blemished ones among them, then wash and soak in cold water over night. In the morning turn off the water and put them in the soup pot, with the cold water and salt pork. Simmer gently seven hours, being careful that the soup does not burn. When it has cooked six hours add the seasoning. Have a large wooden spoon to stir the soup. When done it should be thin enough to pour. By boiling it may become too thick; if so, add boiling water. When thoroughly cooked, the soup is smooth and rather

mealy. If not cooked enough, after standing a few minutes the thick part will settle and the top look watery. At the end of seven hours strain the soup through a sieve and return to a soup pot. Beat the flour and butter together until creamy, then stir into the soup and simmer half an hour longer. If the salt pork has not seasoned the soup sufficiently add a little salt. For some tastes the soup would be improved by the addition of a quart of hot milk.

Serve little squares of fried bread in a separate dish.

Dried Bean Soup

One pint dried beans, four quarts water, one large onion (minced fine), four tablespoonfuls sweet drippings or butter which gives a better flavor, three tablespoonfuls flour, one tablespoonful minced celery or a few dried celery leaves, one-half teaspoonful pepper, two teaspoonfuls salt.

Wash the beans and soak them over night in cold water. In the morning pour off the water and put them in the soup pot with three quarts of cold water. Place on the fire and when the water comes to the boiling point pour it off (throw this water away). Add four quarts of boiling water to the beans and place the soup pot where the contents will simmer for four hours. Add the celery the last hour of cooking. Cook the onion and drippings slowly in a stewpan for half an hour. Drain the water from the beans (save this water) and put them in the stewpan with the onions and drippings. Then add the flour and cook half an hour, stirring often. At the end of this time mash fine and gradually add the water in which the beans were boiled until the soup is like thick cream. Then rub through a puree sieve and return to the fire; add the salt and pepper and cook 20 minutes or more. Any kind of beans may be used for this soup; the Lima beans give the most delicate soup, but the large or small white beans are very satisfactory and are less expensive than the Limas.

In cold weather the quantities of beans and flavorings may be doubled, but only six quarts of water are used. The resulting thick soup can be kept in a cold place and a portion boiled up as required and thinned with meat stock or milk.

Cream of Bean Soup

Make as above, but add only enough of the water in which the beans were cooked to make the mixture like thin mush. Have this very hot and add boiling hot milk to make it like thick cream, about a quart of milk to three pints of the bean puree. Boil up at once and serve. It spoils a cream soup to let it cook many minutes after the milk is added.

SPINACH

To clean the spinach cut off the roots, break the leaves apart and drop them into a large pan of water; rinse them well in this water and put them in a second pan of water. Continue washing in clean waters until there is not a trace of sand on the bottom of the pan in which the vegetable was washed. If the spinach is at all wilted let it stand in cold water until it becomes fresh and crisp. Drain from this water and cook. For half a peck of spinach have in a large saucepan three quarts of boiling water and one tablespoonful of salt. Put the drained spinach in the boiling water and let it boil 10 minutes, counting from the time it begins to boil. When it begins to boil draw the cover of the saucepan a little to one side to allow the steam to escape. At the end of 10 minutes pour the spinach into a colander, and when the hot water has passed off pour cold water over it. Let it drain well and mince coarse or fine, as is suitable for the manner in which it is to be served.

One peck of spinach will make about one and a half pints when cooled and minced.

Spinach With Cream

One-half peck spinach, two tablespoonfuls butter, one tablespoonful flour, one teaspoonful salt, one-half teaspoonful pepper, one-half pint cream or milk.

Cook and mince the spinach. Put the butter in a saucepan and on the fire. When hot add the flour and stir until

smooth and frothy, then add the minced spinach and the salt and pepper. Cook for five minutes, then add the milk or cream, hot, and cook three minutes longer. Serve.

Spinach With Egg

One-half peck spinach, three tablespoonfuls butter, one-half teaspoonful pepper, two eggs, three teaspoonfuls salt.

Wash and cook the spinach, using two teaspoonfuls of the salt in the water in which the vegetable is boiled. Drain and chop rather fine, return it to the saucepan and add the salt, pepper and butter. Place on the fire and cook 10 minutes. Heap in a mound on a hot dish and garnish with the hard-boiled eggs, cut in slices.

Spinach Cooked Without Water

Fresh spinach when washed holds enough water for cooking. Put the spinach in a stewpan and on the fire; cover and cook for 10 minutes. Press down and turn the spinach over several times during the cooking. At the end of 10 minutes turn the spinach into a chopping bowl and mince rather fine. Return to the stewpan and add the seasonings, allowing for half a peck of spinach two generous tablespoonfuls of butter and a teaspoonful of salt. Simmer 10 minutes; or, if very tender, five minutes will be sufficient.

Spinach cooked in this manner will retain all its salts. It will be more laxative and the flavor stronger than when blanched (boiled in water). In young, tender spinach this is not objectionable, but when the overgrown vegetable is cooked in its own moisture the flavor is strong and somewhat acrid.

SQUASH

The various varieties of the summer squash are generally cooked when so small and tender that the thumb nail can pierce the rind easily.

To prepare for the table wash the squash, cut into small pieces and either cook in boiling water or steam it. It will cook in boiling water in half an hour. It takes about an hour to cook it in the steamer. The cooked squash is mashed fine and seasoned with salt, pepper and butter. This method gives a delicate flavored but rather watery dish.

Summer squash is very palatable cut in slices and fried like eggplant.

It is claimed by many that the very young summer squashes, particularly the turban variety, or "cymlin" of the Southern states, are very delicate and palatable cooked whole. For this dish they should not be much larger than a silver dollar. The crook-necked and other summer squashes are richer in flavor when grown to a large size. From the more mature squash remove the thin skin and seeds. Cut the squash in small pieces and put in a stewpan with boiling water enough to cover. Boil for half an hour. Drain, mash and season with salt, pepper and butter.

Cook winter squash in the same manner. Squash is one of the vegetables that requires a good deal of butter.

SWISS CHARD

This vegetable is a variety of beet in which the leaf stalk and midrib have been developed instead of the root. It is cultivated like spinach and the green, tender leaves are prepared exactly like this vegetable. The midribs of the full-grown leaves may be cooked like celery.

TOMATOES

To Peel Tomatoes

Put the ripe tomatoes into a dish and pour boiling water over them. Let them rest in the water about one minute; then pour the water off. The thin skin will now peel off readily.

When a quantity of tomatoes are to be peeled have a deep stewpan a little more than half filled with boiling water and on the fire where the water will continue to boil. Put the tomatoes in a frying basket and lower into the boiling water. Let the basket remain one minute in the water. There must, of course, be water enough to cover the tomatoes.

Stewed Tomatoes

Peel the tomatoes and cut into small pieces. Put into a stewpan and on the fire. Boil gently for 20 minutes or half

an hour, counting from the time it begins to boil. Season five minutes before the cooking is finished. Allow for each quart of tomato one generous teaspoonful each of salt and sugar and one tablespoonful or more of butter.

Escalloped Tomatoes

One pint peeled and cut tomatoes, one pint grated bread crumbs, one level teaspoonful salt, one tablespoonful butter, a suggestion of pepper.

Reserve three tablespoonfuls of the bread crumbs and spread the remainder on a pan. Brown in the oven, being careful not to burn them. Mix the tomato, browned crumbs, salt, pepper and half the butter together and put in a shallow baking dish. Spread the unbrowned crumbs on top, and dot with the remainder of the butter, cut into bits. Bake in a moderately hot oven for half an hour. The top of this dish should be brown and crisp.

Tomato Toast

Boil one quart of peeled and cut tomatoes for 10 minutes, then rub through a strainer. Return to the stewpan and add two level teaspoonfuls of salt, half a teaspoonful of pepper and two tablespoonfuls of butter. Place on the fire and cook five minutes. Have the bottom of a hot platter covered with well-toasted slices of bread and pour the hot tomato over it. Serve at once. A dropped or poached egg may be put on each slice of toast.

Tomato Jam

Wash the tomatoes well, selecting sound, ripe, deep red tomatoes. Remove the stem and slice them into a preserving kettle. Heat and cook gently until they can be pressed through a sieve to remove the skins and seeds. Return to the kettle and add an equal weight of sugar; and to each pound the grated yellow skin and juice of two lemons. Boil until clear and thick and then seal up when cool.

Fish Steak, Tomato Dressing

Dip two slices of fish steak in flour, fry in covered skillet until done brown on both sides. In another skillet put two tablespoons of butter, add to it some parsley cut fine and four small onions and let fry until onions are cooked a light brown, then add the solid part from a can of tomatoes, salt and pepper, half teaspoonful of Worcestershire sauce and let all come to a boil. Remove fish to platter and pour sauce over it.

Baked Tomatoes With Cream Sauce

Select sound, ripe, medium-sized tomatoes. Wipe, prick several times with a fork, arrange in pan and bake in a moderate oven. Remove skins, place on rounds of sauted bread and pour over them a rich white or cream sauce.

Deviled Tomatoes

Wipe, peel and cut four tomatoes in slices. Sprinkle with salt and pepper, dredge with flour and sauter in butter Arrange on a hot platter and pour over them the following sauce:

Work four tablespoonfuls of butter until creamy and add two teaspoonfuls of powdered sugar, one teaspoonful of dry mustard, one-half teaspoonful of salt and a few grains of cayenne. When thoroughly blended, add one egg, slightly beaten, the yolk of one hard-boiled egg, rubbed to a paste and two tablespoonfuls of vinegar. Cook over hot water, stirring constantly until mixture thickens.

TURNIPS

Boiled Turnips

Have the turnips peeled and sliced. Drop the slices into a stewpan with boiling water enough to cover generously. Cook until tender, then drain well. They are now ready to mash or chop. If they are to be served mashed, put them back in the stewpan; mash with a wooden vegetable masher, as metal is apt to impart an unpleasant taste. Season with salt, butter, and a little pepper. Serve at once.

Hashed Turnips

Chop the drained turnips into rather large pieces. Return to the stewpan, and for a pint and a half of turnips add a teaspoonful of salt, one-fourth of a teaspoonful of pepper, a tablespoonful of butter, and four tablespoonfuls of water. Cook over a very hot fire until the turnips have absorbed all the seasonings.

Serve at once. Or the salt, pepper, butter, and a tablespoonful of flour may be added to the hashed turnips; then the stewpan may be placed over the hot fire and shaken frequently to toss up the turnips. When the turnips have been cooking five minutes in this manner add half a pint of meat stock or of milk and cook ten minutes.

Maria Parloa,
Washington, D. C.

Red Astrachan Apple for Massachusetts. See *Massachusetts*.

Red Spiders or Mites. See under *Apple Pests* and *Currant Pests*.

Rhode Island Greening Apple for Massachusetts. See *Massachusetts*.

Rhode Island

Rhode Island is the smallest state in the Union and is often called "Little Rhoda." Its extreme length is 48 miles, its extreme width is 36 miles, and it contains 1,250 square miles of territory.

The general surface of the state is undulating and hilly, but the hills are low, the highest reaching an altitude of only 850 feet. On the east and south the coast line is indented with bays and navigable inlets, the chief of which is Narragansett bay. Then there are lakes and islands, all of which add to the beauty of the scenery and tend to modify the climate. Over the whole state there are evidences of deposits from glacial drifts and the soil is fairly productive. As compared with the other New England states the climate is mild. The rainfall is sufficient for the growing of all kinds of farm crops, ranging from 40 inches in the northwest to 50 inches per annum near the coast.

Rhode Island, partly on account of its size, is not an important commercial fruit-producing section. The total number of apple trees reported in the census of 1910 was 152,009; total number of peaches, 39,342; pears, 16,907; plums and prunes, 4,836; cherries, 964; grapes, 7,662 vines; small fruits, 281 acres.

Granville Lowther

Production of Fruits in Rhode Island

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard fruits, total		215,798		94,564	245,822	$197,639	360,298
Apples	3,327	152,009	1,005	54,560	212,908	147,125	339,445
Peaches and nectarines	814	39,342	516	30,795	17,704	30,609	6,140
Pears	1,781	16,907	382	5,405	12,501	14,577	12,452
Plums and prunes	533	4,836	241	2,556	1,872	3,586	571
Cherries	310	964	143	453	214	464	1,329
Apricots	13	46	11	39	5	11	12
Quinces	364	1,694	143	756	618	1,267	(2)
Unclassified							[3] 349
Grapes....	534	7,662	119	9,634	152,937	9,759	189,700
Nuts		[4] 47		[4] 5	[4] 1,545	[4] 49	4,200
Tropical fruits, total	4	183	1	3	1,090	397	.....

[1] [illegible] bushels for orchard fruits, and pounds for grapes, nuts and tropical fruits.
[2] [illegible]
[3] [illegible] of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes English or Persian walnuts, pecans, black walnuts, butternuts chestnuts and hickory nuts.

The total quantity of orchard fruits produced in 1909 was 246,000 bushels, valued at $198,000. Apples contributed about seven-eighths of this quantity; peaches and nectarines and pears most of the remainder. The production of grapes amounted to 153,000 pounds, valued at $10,000, while that of nuts and of tropical fruits was relatively unimportant.

Small fruits: 1909 and 1899. Strawberries were by far the most important of the small fruits grown in Rhode Island, with cranberries ranking next in quantity, and raspberries and loganberries next in value. The total acreage of small fruits in 1909 was 281 and in 1899, 581, a decrease of 51.6 per cent. The production in 1909 was 438,000 quarts, as compared with 580,000 quarts in 1899, and the value $43,000, as compared with $51,000.

The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	. . . . . .	281	581	437,560	$43,033
Strawberries	545	140	154	326,540	31,712
Blackberries and dewberries	69	16	17	17,875	1,927
Raspberries and loganberries	154	34	57	32,871	4,197
Currants	130	12	26	17,110	1,564
Gooseberries	43	8	5	8,251	852
Cranberries	127	70	300	34,688	2,734
Other berries	2	1	22	225	47

Rhubarb

Rhubarb has been used in medicine from very early times, being described by the Chinese herbal Pen-king, which is believed to date as far back as 2700 B. C. In the 14th century the plant appears to have found its way to Europe by way of the Indus and the Persian gulf, to the Red sea and Alexandria, and was described as East Indian rhubarb. Some also came by the way of Persia and the Caspian sea to Syria and Asia Minor, reached Europe by the way of Aleppo and Smyrna, and became known as Turkey rhubarb. Subsequently to the year 1653, when China permitted Russia to trade on her frontiers, Chinese rhubarb reached Europe by the way of Moscow, and in 1704 the rhubarb trade for Europe became a monopoly of the Russian government, in consequence of which Russian or "crown" rhubarb was the name applied to it.

Propagation

Plants are easily grown from seed, but can be obtained in much shorter time by division of the root. Divisions or seedlings are planted about three feet apart in ground which has been deeply trenched and manured, the crowns being kept slightly above the surface. Rhubarb grows freely under fruit trees, but succeeds best in an open situation in rich, rather light soil. The stalks should not be pulled during the first season. If a top dressing of manure is given every autumn, the plant should be good for several years.

Planting

* When sown in the open ground the seeds are placed in drills one inch deep, the drills being from one foot to eighteen inches apart. When the plants appear they are thinned to stand three or four inches apart. A good, well-prepared soil should be chosen for the purpose, and good cultivation given subsequently, and the rows kept free of weeds. The following spring the young plants are set out in their permanent places, the usual distance between plants allowed being four feet each way, with crowns three to four inches deep. Deeper planting is not desirable. A planting estab-

* E. Walker, Arkansas Experiment Station

lished is allowed to stand four or five years, when the crowns are taken up and divided and a new planting made. The crowns become very large after a few years and the stalks tend to become small.

Some growers plow or dig trenches where the rows are to run, placing a few inches of rotted manure in the bottom below the plants, and allow the plants to remain eight to ten years, but this increases the expense, and ordinarily the other method is to be preferred.

Under favorable conditions the leaves and stalks grow to enormous size, and at the distances named almost completely shade the ground, crowding out weeds. Cultivation, however, should be given one way to keep the soil from becoming hard and dry. No cropping should be allowed till the third year. Each fall there should be a broadcast application of ten to twelve cords of manure. This should be cultivated into the soil, and the ground thoroughly worked over again in the spring. Manure along the rows should be forked under. Cultivation is suspended during the bearing season. Hence the importance of thoroughness in the early working. After the bearing season is past cultivation should be resumed.

Harvesting and Marketing

The leaves are gathered by pulling them off. This operation requires care to avoid unnecessary injury to the young leaves and crowns, and to have the stalks come off at the very base two or three inches below the ground. The leaves are gathered up and taken to a shed where they are tied in bundles, cutting off the leaf proper a couple of inches from the stalk. In forced rhubarb the undeveloped leaf is not removed, its bright yellow color adding to the attractiveness of the bundles. For local market the stalks are cleaned of hulls and washed, but for shipment the stalks are cleaned by simply brushing off the dirt. The stalks are tied at bases and near the tops with ordinary binding twine or raffiia, into bunches of three or four stalks, and these again formed into bundles of a dozen bunches. This method is a convenience for the retail merchant. For shipment, these bundles are wrapped in paper and boxed six or more bundles to a box. Again the single stalks are tied nearly at top and base, into bundles of twenty-five to thirty pounds, or loose packed in boxes of about a barrel capacity. Weights are marked on the package or on attached tag at the time. In such matters one must be governed by the requirements of the market. Neatness in packing, and a good article, however, are always in order.

Growers dispose of their crops in various ways—in the local market, to grocers, hotels or private families, or to dealers in more or less distant cities, and commission merchants. Care must be taken that the rhubarb is not frozen in shipment. Express shipment consumes much of the profit, but is the only safe way for small quantities.

Common yields are from 16,000 to 20,000 pounds per acre in the open air. The price varies according to the season, market, etc. It seldom brings less than one cent per pound. The forced and early pickings bring the best prices, from five to fifteen cents per pound being frequently realized.

Forcing

Rhubarb is readily forced, the expensive appliances needed in the case of many other crops when brought in out of season being wholly unnecessary. The business is carried on to a considerable extent in the neighborhood of many of the large cities of the country. This early product finds a ready market at good prices.

Cold frames, the cellar, or cheap forcing houses may be used for the purpose. Sash and glass are unnecessary, as the crop does not require light—warmth and moisture only being needed. For use in forcing only strong well-grown roots two or three years old are used. At the low temperature commonly furnished when the plants are forced in cold frames or cellars, it is important that the roots used shall have been frozen. Here they should be dug with what earth adheres to the roots, and left on the surface of the ground until they have been solidly

frozen. They may then be covered with litter or straw to prevent alternate freezing and thawing. They may be forced without freezing in hotbeds, or where given higher temperature, but high temperature gives a poor product, a smaller crop and more fully exhausts the roots.

The roots are commonly placed in position for forcing early in February, the time required being from four to six weeks, according to the temperature supplied. This varies from 45 to 75 degrees. The best yields and results are obtained at the lower temperature. The roots are packed closely together on the ground or floor of the structure used. The spaces between the roots are filled in with soil. No water is required until growth has started actively. It may then be given freely.

A few roots will provide a supply for early home use, and may be easily forced in a corner of the cellar, partitioned or curtained off for convenience in heating. A small coal oil stove or a couple of lanterns will supply warmth. A large dry-goods box may answer. The space under the stages of a conservatory or greenhouse may be also used by curtaining or boarding up to exclude light. Ordinarily the temperature in such places is higher than necessary, and the results are not as satisfactory as in a cellar. The roots should not be placed too near the heating pipes. A small box put in a well-drained place on the south side of the house or other buildings may be used, the warmth being supplied by a covering of boards and piling manure about the sides a foot or so thick, and over the top to half that depth. A barrel or box so arranged may be placed over a clump in the garden for supplying a few early stalks.

For forcing on a larger scale a good-sized cellar or a cheap building made for the purpose may be used, the heat being supplied by a flue, a stove, or in case of a permanent structure by means of steam or water pipes. A shed or large cold frame built of rough boards covered with building paper and roofed over the same way or with sash, may be used for the purpose. It need not be over five feet high at the sides, the width and length being according to convenience. The walls may be lower, provided walks are sunken a foot or more deep through the length of the shed. The heat may be supplied by means of a flue or a stove in case the structure is of moderate size, placing the stove and the pipe so as to secure as uniform distribution of the heat as possible. It will be desirable to have the stove stand in a small vertical-walled pit with ample space about the sides and let the pipe in passing outward to the end of the house and chimney run neither close to the roof nor to the ground. Placing the stove in the pit secures a better circulation of the air in the house and more uniform heating. The ordinary King or Wilson (sheet iron) heater, with the opening in the top, is well suited for the purpose of heating a moderate sized shed or pit. A damper in the pipe near the outlet, together with that on the stove, gives a very fair control of the heating after a little experience.

In general the arrangement here described is well suited to the needs of those having a small conservatory or pit to be heated. The heating of such without too much care and expense has always been a problem. When not in use the heater is removed from the pit and stored. If left in the pit it rusts out in the course of about two seasons.

Having the general idea as to forcing rhubarb, it is an easy matter to adjust the details according to the requirements of the operator. In some cases rather compact permanent plantings are made in the soil and the house built over them, giving the plants open culture during summer by removing the sash or other covering. Sometimes half the house being forced one year, the rest the next.

Forced rhubarb is very attractive in appearance. The stalks grown in the dark assume a very bright, crimson color. The leaf blades remain small and undeveloped, taking on a bright yellow. The quality is also very superior, having a delicacy not found in the open-air pro-

duct. Forced rhubarb brings from eight to 15 cents per pound.

The roots, if not highly forced, may be used for division and planting out. They regain their vigor after two or three seasons, with good care. A supply of roots must be kept coming on when forcing is regularly undertaken. Seedlings and divided roots may be rendered suitable for use earlier by liberal manuring and high cultivation.

Roads

The subject of Good Roads is one that is of considerable importance to the fruit grower. The general farmer can haul his product to market without any considerable damage on account of rough roads; his loss in hauling over bad roads is mainly in the fact that it takes more power to transport a given amount of the farm produce to the market than it requires where the roads are good. But with the fruit grower there is the additional reason that in hauling over bad roads his fruit is damaged by jolting, bruising, disarranging the pack, etc., so that when it reaches the market it is of less value and brings a less price than if it reached the market in good shape.

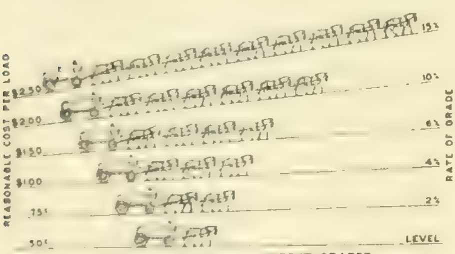


Fig. 1. An Illustration of the Difference in Power Required on the Different Grades From That of a 15 Per Cent Grade Down to the Level Grade.

An instance is given by a Wisconsin farmer who held 1,000 bushels of potates in his cellar waiting for a good price. He was offered 92 cents in March, but they must be delivered in town and the roads were so bad he could not haul over them. When he finally got them to market, his potatoes brought him 30 cents a bushel. Bad roads, therefore, cost him $620.

In many cases it is not necessary that a great deal of money be spent on the roads, but what is invested should be used carefully and intelligently. A few dollars spent at the right time will save repairs costing hundreds of dollars, and most of the roads where there is no heavy through travel may be improved in this way. The average cost for sand-clay roads is but $723 per mile for the 24,601 miles of such roads said to be in use in

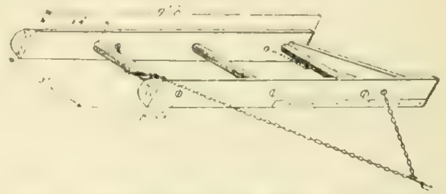


Fig. 2. Split Log Drag Used for Keeping Dirt Roads in Repair.

the United States. This may be compared with a cost of $4,989 per mile for macadam; in other words, about seven miles of good sand-clay road can be built for the same money as one mile of plain or water-bound macadam. The cost of maintenance is also less than for any other form of improvement, except earth road, and horses and automobilists alike prefer it to any of the hard-surface roads.

GRANVILLE LOWTHER

Rodents

"Digger Squirrels" or Ground Squirrels

H. F. WILSON

The ground squirrels are of great economic importance, not only because of the injury to grain, fruit trees, etc., but because the United States Public Health and Marine Hospital Service has recently found that one of the California species is a carrier and disseminator of plague.

These animals do considerable damage to young trees and scions by climbing them and eating the buds and stripping away the leaves. Dr. C. Hart Merriam, of the United States Biological Survey, is authority for the statement that ground squirrels are good to eat and were at one time regularly sold in the markets of San Francisco. He also states that

they are much prized as food by the Indians.

Methods of Destruction

Traps may be used with good success, and the Washington Experiment Station states that they have found this to be the most desirable method of getting rid of them. Ordinary steel traps No. 0 or No. 1 placed unbaited and as far down in the burrow as the chains will permit.

Poisoning

The following formula is recommended by Mr. Merriam. "Strychnia sulphate one ounce, borax two ounces, crushed wheat, rolled oats, acorn meal or corn meal 20 pounds. Dissolve the strychnine and borax in two quarts of hot water in a closed vessel, stirring occasionally for 20 minutes or until completely dissolved. Then add four quarts warm water (in which one-fourth pound of honey may be dissolved) and sprinkle the solution over the crushed grain or meal, stirring or mixing thoroughly until absorbed. Half a teaspoonful of this should be placed at the entrance of each occupied burrow." Cut pieces of carrot and sugar beet or other vegetable into which strychnine crystals have been inserted are effective. Prunes and raisins so treated have been recommended by several orchardists in this state.

Crude bisulphide of carbon may be used to a good advantage where the animals are thick. Two persons working together can cover considerable ground in a day and destroy many squirrels. It should only be placed in burrows where squirrels have been seen to enter, otherwise many empty burrows may be treated, which is a waste of time and materials. Using pieces of horse manure, corn cobs, lumps of earth or other absorbent material, pour about a tablespoonful of carbon bisulphide on each piece and throw it as far down the burrow as possible, immediately close the opening. This is best done just after a rain, as the water in the ground tends to keep the gas in the burrow.

Shooting is decidedly effective and affords amusement during resting hours.

To Kill Large Ground Squirrels

A. G. Craig

Take four gallons cheap sugar and enough water to make five gallons of syrup. Heat to a boiling point and add one and one-third ounces strychnine, and boil for five minutes. The syrup can be bottled and kept indefinitely. When ready to use, saturate rolled barley with the hot syrup. As much of the syrup should soak into the barley as is possible. Place a large tablespoonful of the mixture at one side of the holes. The squirrels are very fond of the sweet barley and it is sure death.

We have tried several things to soak up the syrup but find that the rolled barley gives the best satisfaction. Any cheap syrup may be used in place of sugar, so long as it is sweet enough. All receptacles should be labelled "poison." We have used it throughout the season, but the squirrels can be controlled much cheaper, by using the mixture as soon as they come out in the spring.

Field Mice

H. F. Wilson

Perhaps these little animals cause far more damage than they are accused of, as they are directly responsible for a great deal of the damage which is ordinarily laid to moles and shrews.

The quantity of green vegetation eaten by a single adult field mouse in the course of a year has been calculated at from 24 to 36 pounds, and on that estimate a thousand would require twelve tons of grass or other vegetation to maintain them for a year.

Methods of Destruction

Thorough cultivation of fields tends to keep down the number of mice. Cultivation implies the destruction of weeds and all the annual growths that provide winter shelter for the animals. The mere plowing of a field badly infested with mice is sufficient to drive out most of them. While a high state of tillage does not always bring immunity from mice, it does much to lessen the danger of attacks from them.

All things considered, strychnine is the

most satisfactory poison for field mice. Although a deadly substance, it is less dangerous to handle than either phosphorus or potassium cyanide. For poisoning field mice various baits may be used, such as wheat, oatmeal, or corn. The bait should be soaked over night in a poison syrup, which may be prepared as follows: Dissolve an ounce of strychnia sulphate in a pint of boiling water, adding a pint of thick syrup and stir thoroughly. The prepared syrup may be scented with a few drops of oil of anise. The above quantity is enough to poison a half bushel of wheat or corn, but smaller proportional quantities of grain or syrup may be prepared as needed. After thoroughly mixing the solution if it is too wet a little dry corn meal will take up the excessive moisture. If the solution is not sufficient to wet the grain thoroughly add a little water.

Because of the danger of destroying native birds, such as quail, sparrows, and others, the poisoned bait should not be placed in exposed situations, but under shelters which will admit mice but exclude birds. Wide boards lying upon thin cross-pieces of wood are excellent for this purpose.

Moles

The moles thrive best in a loose moist soil containing an abundant supply of grubs and earthworms. There are two parts to its system of runways, the deeper channels leading to underground chambers, and the shallow surface channels ranging over the hunting grounds. During the rainy season in the fall they seem to be most active. It is generally considered that the diet of moles consists of insects and worms, although pieces of vegetable matter have been found in their stomachs. Whether they do or not, in all justice to them as destroyers of insects, we should explain that many mice run about in their burrows and undoubtedly do most of the damage to seeds, roots, etc., laid to the moles.

In general moles are beneficial, but that does not mean that they should be allowed to work in small gardens, lawns, etc., because of the disfigurement caused thereby.

Destruction of Moles

All methods which may be employed are more or less unsatisfactory.

Trapping is probably the most practical method, and after a little experience one can become quite efficient at setting the trap in the right place. Success depends a great deal upon the operator's proper knowledge of the mole's habits. When ready to set the trap one should locate a place in the surface runway where fresh work can be seen—press down firmly the burrow at one spot for a little more than the length of the trap—do not disturb any other part of the burrow. Of the large number of mole traps on the market there is probably not much difference in their efficiency, but one should be sure to secure proper instructions for operating the ones tried. Directions for setting the trap should be given with each trap sold. Small steel or spring traps set in their runways are useless as the moles will burrow under or around them without noticing any bait placed in them.

Poison

Of all the methods tried by various experiment stations the following from the Michigan State Agricultural College seems to be the best. Remove the seeds from raisins and insert instead crystals of strychnine. Insert into burrow through a small hole made with a sharp stick.

Rolling the lawn is a very good practice to follow where moles are working in the lawn, repeated rollings seem to discourage the moles and compacts the dirt around disturbed grass roots, as well as leveling the ridges.

Pocket Gophers

H. F. Wilson

The ridges and mounds of earth thrown up by moles are often incorrectly supposed to be the work of gophers. A few careful observations will show the difference.

The gopher piles up the dirt on the surface of the ground, building a mound by the addition of load after load on top

of that already deposited. A mole simply heaves up the dirt from beneath, forming piles which show radiating cracks. Associated with these piles are the surface ridges made by the animal when ranging in search of food. The feeding runways of the gopher never show in surface ridges.

The natural food of the gophers consists of the fleshy roots and underground stems of various plants. They are busy at almost every season of the year (unless the ground be frozen hard) but are more so in the spring and fall.

Methods of Control

Poisoning is the best method for destroying this animal, although traps and fumigation are used to some extent.

Fig. 1. Shows One Form of Trap Used, "Cinch" Trap.

The most successful poison is prunes, raisins, pieces of apple, potato or some other vegetable into which crystals of strychnine have been inserted. The pieces containing the poison must be inserted into the burrows. The burrows are easily located, running on a direct line between two mounds of earth, and one should have a sharp stick with which to make a hole into the burrow. After the poison is placed it is better to leave the hole uncovered, as the gopher noticing the light will be attracted by it.

Raisin Formula

A. G. Craig

To prepare raisins to poison gophers, take a raisin, punch a hole in it with a toothpick, then place a large grain of strychnine into the hole, and roll the raisin in the fingers until the strychnine is broken up and mixed with the pulp of the raisin. Prepare as many raisins as necessary for the day.

The gopher's mound is almost always located on a short run from the main run or hole. Dig down at the mound until the branch is located, and follow the branch until the main run is reached. Place two treated raisins in the run on each side of the branch run and cover the hole with a shingle or chip and soil. If any new mounds are thrown up, repeat the treatment. We have found it a sure remedy.

Roselle

Roselle is sometimes called the "Mock Cranberry." It is adapted to Southern Florida, California and Texas, and is so much like cranberry sauce, when prepared, that it is highly prized and is described in substance as follows by J. P. Wester, formerly of the U. S. Bureau of Plant Industry. Mr. Wester's description was published in the Country Gentleman of March 7, 1914.

Roselle, *Hibiscus sabdariffa L.*, is an annual plant of the mallow family considerably resembling the cotton plant in general aspect. It grows to a height of from five to seven feet, has profusely branching reddish stems, and bears large yellow flowers, each with a red eye. Aside from its uses as a fiber-plant—to which little attention has been paid in this country—it was, until recently, grown entirely for the reddish fleshy calyxes surrounding the seed pods. These yield a brilliantly colored jelly or jam, and can also be used for making wine. The plant is exceedingly sensitive to frost, and its culture has accordingly been limited hitherto to tropical and subtropical countries. A new era for roselle began, however, with the recent discovery by Mr. Wester that the leaves and stems yield products little if any inferior to those furnished by the calyxes. This discovery not only increased the value of the plant in the far South, but also greatly extended its possible range of cultivation. For the herbage alone it can be grown almost anywhere, as in this case it is harvested before the season of frost.

Blooms Late in October

As now cultivated in the Southern states roselle is usually planted in February or March. It has the peculiar habit of blooming late in October, regardless of the time of planting; thus, plants sown in June blossom almost simultan-

eously with those sown in February. The plants from early sowing grow to greater size but bear smaller calyxes than those planted later. Almost any rich or well-fertilized soil is suitable for its cultivation, but badly drained lowlands subject to inundation should be avoided. As the roots are rather long the land should be deeply plowed. Stiff clay soil must be well pulverized. The plant is subject to attack of nematode worms and should not be grown in a soil infested with this pest.

As a rule the seed is sown thinly in a frame or seedbed in drills six inches apart, covered from one-quarter to one-half inch, and the soil is then firmed and watered. The seed germinate in a few days. The seedlings are transplanted to the field when three or four inches high. Another plan is to plant directly in the field, four or six seeds to a hill, the plants as they develop being thinned to one plant to a hill. Thinnings may be used to reset hills where the seeds have failed to germinate. In either case if grown for the calyxes alone the plants in the field should be placed in rows from six to ten feet apart and from four to eight feet apart in the row. If grown for the herbage, as well as calyxes, the seed should be sown thinly in drills from two to three feet apart. After the last cutting of herbage two out of every three rows may be plowed up and the middle space cultivated, leaving the remaining plants plenty of room for growth to the flowering stage, after which the calyxes are cut.

In the early stages of growth thorough weeding and shallow cultivation are necessary, but may be discontinued as soon as the plants have spread enough to shade the ground and choke out the weeds. Fertilizer should be applied at the rate of from one thousand to two thousand pounds to the acre. In sandy and leachy soil it is found advantageous to make several small applications instead of applying the whole at the time of planting.

In view of the fact that jelly, syrup and wine—though not sauce or jam—can be made from the herbage of the young plants, the most productive method of harvesting is to cut the plants two or three times before the period of blossoming. They should be cut to two or three inches above the ground, the weeds hoed out between the stubble, and the land irrigated. The stubble promptly sprouts, and in the course of a month or so the plants have grown enough for another cutting. Finally the plants are allowed to blossom, and about three weeks later the calyxes are ready for a first picking. If the field is gone over every few days and the full-grown calyxes are picked, the plants will send out new flower buds and may thus be forced to fruit continually from October to February.

Roselle Jelly and Jam

In using the calyxes for making sauce or jam the seed pods must be removed, but this is not necessary in making jelly. The pods are removed by cutting off the stem and the base of the calyx, and forcing out the pod with the finger. The jelly, syrup and wine made from the herbage are said to be equal in flavor to those made from the calyxes, but have not the same bright red color. As already stated, a very good imitation of cranberry sauce can be made from the calyxes.

The following recipe is used in the Philippines for making jelly from the whole plant—leaves, stems, calyxes and pods: Having rinsed and cut up the material, add one quart of water to each two heaping quarts of material, boil for 30 or 40 minutes, and strain. To each quart of juice obtained add one pint of sugar, and allow the latter to dissolve; then boil over a slow fire for about 20 minutes, or until the syrup jellies. Do not stir the syrup in the act of boiling.

The same recipe applies to making jelly from the calyxes. In making jam, one quart of water is used to four quarts of seeded calyxes.

There are now several improved varieties of roselle, of which the Victor and the Rico have hitherto proved most successful in ordinary culture. There is also a white-fruited variety.

The only disease to which roselle is subject, so far as is known, is a mildew which attacks the plant in the autumn with the approach of cool and damp nights. It is easily controlled by dusting dry sulphur over the plants in the early morning while the dew is still on them.

Root System of Apple Tree and Other Plants

The root system of the apple tree is different in some respects from other varieties of fruit trees, especially peaches, plums and almonds. These latter fruits root near the surface of the ground, extending their roots laterally near the surface, while the apple, especially some varieties, has a central tap root extending deeply into the soil. It is possible therefore to grow the stone fruits successfully on a soil of less depth than that on which apples could be grown. The root system of the apple is normally as large or nearly as large as the top system and where the soil conditions are favorable extends to very great depth.

We have seen the peach doing fairly well on a soil where it was only 18 inches to hardpan so solid that no roots could penetrate it. On the same land the apple trees were unhealthy, the tap root malformed, sometimes turned upward after having struck the hardpan, and the tree showing every evidence of lack of nourishment.

The fibrous roots are the feeders. The new growth on these fibrous roots is covered with a multiude of minute, unicellular projections known as root hairs. These root hairs come into contact with the film of water which envelops the soil particles, and, absorbing this moisture with its contained food, forces it into the root, where under the combined pressure of the multitude of root hairs it is forced upward into the tree. It is therefore important that there be a soil content that furnishes in proper proportions the food best suited to the health of the tree. Sometimes the mistake is made of supposing that because some barnyard manure is good, more is better. This is the same as supposing that because the human organism needs some acid as part of the food content that more acid is better and a diet made up principally of acids is better yet. This would soon bring its results in disease. It is just so with a tree. There are certain substances necessary for its growth, and health, but they must be properly balanced. In the arid regions of the Northwest most of the soils are rich in mineral substances, but lack humus. However, it is possible through an attempt to supply humus by the application of barnyard manure, to injure the tree by the materials which the manure contains if the application is excessive. In some of the volcanic soils of the Pacific Coast states there is a large content of alkali. This substance, in certain proportions, is a fertilizer and is good for the soil, but in larger proportions it destroys the little root hairs that feed the tree. We have discovered that when a tree is diseased and the disease is manifest in the top, that much more frequently than we have generally supposed, the trouble originated in the root system on account of some injury, lack of opportunity for root expansion, or soil condition that do not furnish a properly compounded food.

Distribution of Feeding Roots of Apples

This is a question of much interest, both in the application of fertilizers and methods of culture.

It raises the whole question as to how deeply we should cultivate; or how deeply we can cultivate without injury to the roots. Suppose we put the "breaking plow" into the orchard and turn over the surface soil to a depth of five inches, are we improving or injuring the trees? Suppose we put the cultivator into the orchard and tear up the soil to a depth of three inches, are we improving or injuring the roots?

What is the effect of clover or alfalfa as compared with the breaking up of the surface roots?

In clean cultivation, do we injure the large roots, so that aphids collect in the wounds, causing galls and other diseases?

Other questions arise, but these are sufficient to show the importance of the subject.

Various experiment stations have investigated this subject, among them the stations of Wisconsin, Illinois, Arizona, Ohio, and the managers of the Woodburn Fruit Farm, in England.

It was found that varieties differ greatly, and that the same varieties differed much under different conditions of soil. The greatest depths of roots observed at the various places were as follows: Wisconsin, 9 feet; Illinois, 5 feet; Arizona, 20 feet.

More evidence was obtained at the Pennsylvania Experiment Station in 1908, both with reference to root distribution and the horizontal and verticle in each of 28 apple trees.

Expt	Variety	Average in 1908	Root length Feet	Vertical range of feeding roots: Range of depth observed inches	Vertical range of feeding roots: Zone of maximum numbers inches
216	Jonathan	9	13.5	1 to 12	2 to 7
216	York Imperial	9	11	1 to 12	1.5 to 7
217	York	15	10.75	1 to 25	2 to 17
217	Gano	15	18.75	1 to 20	2 to 8
217	York	15	16	1 to 18	2 to 10
217	Gano	15	12.5	1 to 24	2 to 16
218	Albemarle	13	18.	1 to 33	1 to 21
218	York	9	10.2	1 to 26	4 to 15
218	Albemarle	13	5.75	1 to 24	3 to 15
218	York	9	15.25	1 to 16	5 to 12
219	Jonathan	6	10.5	1 to 20	2 to 10
219	York	6	11.25	1 to 19	2 to 11
219	Jonathan	6	11.	1 to 19	3 to 13
219	York	6	9.75	1 to 20	5 to 15
220	Baldwin	10	27.	1 to 18	6 to 14
220	York	20	19.75	1 to 24	1 to 8
221	Baldwin	36	39.	2 to 24	5 to 14
221	Baldwin	36	30.	1 to 22	4 to 15
221	Northern Spy	36	36.5	1 to 20	3 to 12
221	Northern Spy	36	45.5	1 to 36	4 to 14
336	Grimes	8	14	1 to 32	2 to 11
336	Smokehouse	8	13.5	2 to 15	3 to 10
336	Stayman	6	14.5	1 to 18	2 to 9
338	Baldwin	20	21.5	1 to 42	2 to 12
338	Baldwin	20	27.75	0 to 20	3 to 10
338	Baldwin	20	36.5	0 to 21	5 to 10
339	Baldwin	14	28.25	1.5 to 18	2 to 11
339	Fallawater	14	25.75	1 to 23	2 to 11
Averages	(28 trees)...	15	19.77	1.7 to 22.16	27. to 12.0

It will be seen by this table that the heaviest rooters are the Spy and the Baldwin. It will also be noted that in two varieties the feeding rootlets are, some of them, at the surface not even one inch below, and that no variety starts its feeding rootlets more than two inches below the surface, while most of them start one inch below. It would seem from this table that unless it is desired for some reason to disturb the feeders, that it is not best to cultivate more than one inch in depth.

See *Deep Plowing*, under *Cultivation of the Apple Orchard*, pp. 234, 236.

Peach Roots

In Ohio, the roots of the peach were examined only to a depth of one foot; but it is stated that in all cases studied, the feeding roots were removed from the first six inches of soil.

Depth of Roots

Corn roots have been known to penetrate the soil to a depth of four feet. On drier and deeper soils they went as deep as eight feet. Perennial grasses have been known to go as far as four feet the first year, and five and a half the next year. Potatoes, 3 feet; sugar beets, 4 feet; alfalfa, from 30 to 50 feet; grape vines, 22 feet.

Dr. W. Frear.

Colorado Agricultural College.

Reduction of Waste in Marketing. See p. 1327.

Roxbury Apple for Massachusetts. See *Mass.*

RYE. See *Apple Orchard Cover Crop.*

SAN JOSE SCALE. See *Apple Pests.*

Score Cards

The following score cards for use in judging exhibition fruits were compiled by R. J. Barnett, Pomologist, Washington Experiment Station:

The relative importance of the different characteristics of fruits is denoted by score cards. It is unfortunate that standard values for the various points have not been developed for fruits as they have for live stock, and that different shows, in the same section even, use different ratings.

For plate displays of one variety a good score card is:

Form	15
Size	15
Color	20
Uniformity	25
Freedom from blemishes	25

If quality were a factor, one variety competing against another, this would be modified as follows:

Form	10
Size	10
Color	20
Uniformity	20
Freedom from blemishes	20
Quality	20

The British Columbia Horticulturist recommends:

Form	15
Size	15
Color	25
Uniformity	25
Freedom from blemishes	20
	100

The Society for Horticultural Science recommends as follows, plate exhibits:

For apples and pears	
Form	15
Size	15
Color	20
Uniformity	20
Freedom from blemish	30
For Plums	
Form	10
Size	25
Color	20
Uniformity	20
Freedom from blemish	25
Peaches and Cherries	
Form	10
Size	20
Color	25
Uniformity	20
Freedom from blemish	25

In all the above quality, when scored, 25.

Grapes	
Form of bunch	10
Size of bunch	15
Size of berry	10
Color	10
Uniformity	10
Freedom from blemish	20
Quality	20
Firmness	5

For Boxes of a Given Variety

Fruit		
Texture and flavor	100	
Size and form	100	
Color	150	
Uniformity	150	
Freedom from blemishes	150	
		650
Box—		
Material	30	
Marking	10	
Solidity (nailing, cleats, etc.)	10	
		50
Pack –		
Bulge or swell	100	
Alignment	20	
Height of ends	60	
Attractiveness and style	40	
Compactness	80	
		300
Total		1,000

The National Apple Show Score Card

Quality (all alike perfect within a variety)	20
Color	20
Size	10
Uniformity	10
Condition (including blemishes)	20
Pack	20
Total	100

Pack is subdivided as follows:

Bulge	4
Alignment	4
Height of ends	4
Compactness	4
Attractiveness and style	4
Total	20

Unless the entries are numerous, the judge wil not use the score card, but will keep the values in his mind and score by inspection, especially in plate exhibits. The exhibitor should, however, make himself quite familiar with the various points to be considered and the value attached to each of them.

District Display

The Interstate Fair uses the following score card for this class of displays:

Quality	60
Variety	20
Arrangement	20
Total	100

SATSUMA ORANGE. PROFITS FROM. See *Alabama.*

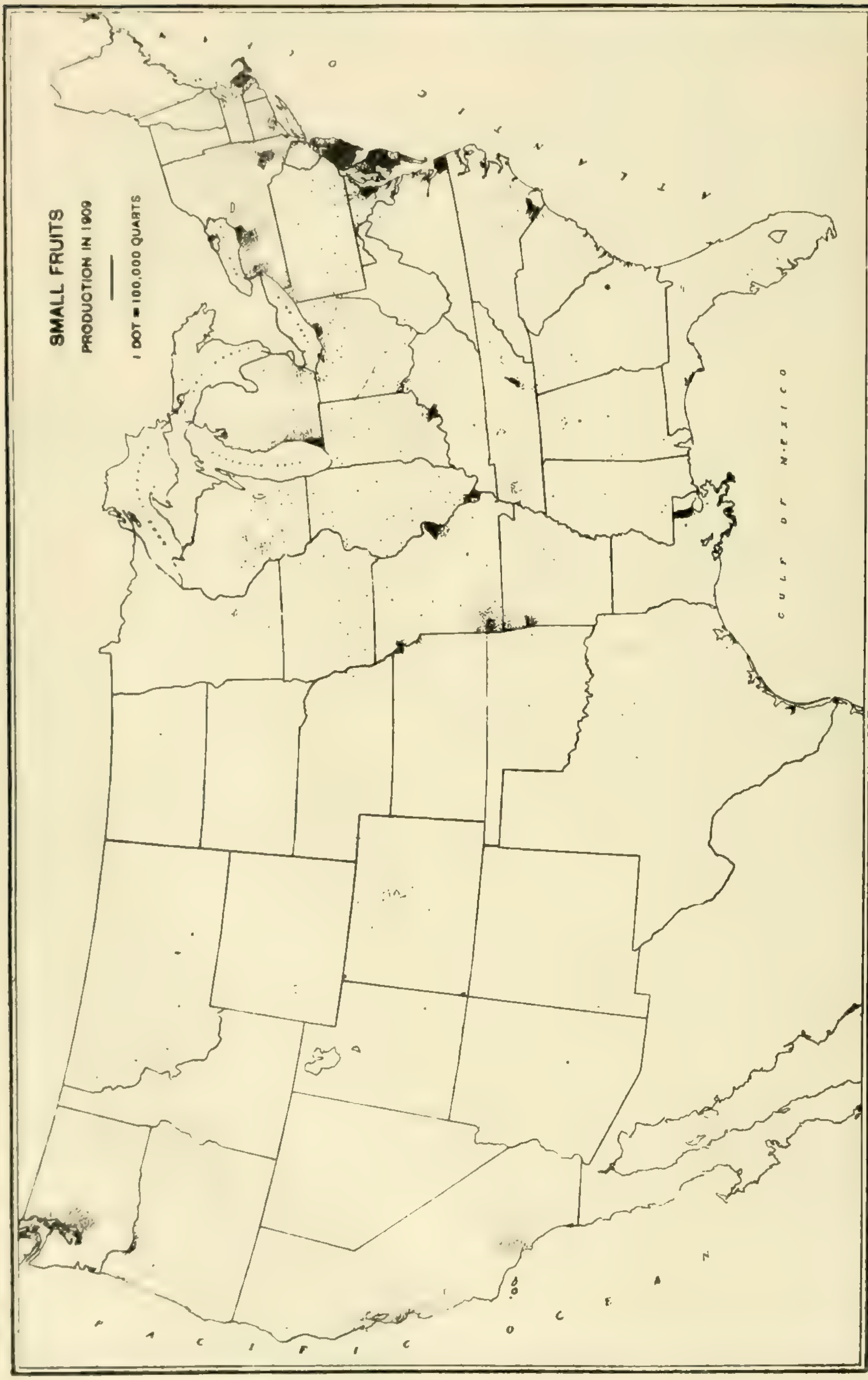
Seed per Acre

Quantity Required for Sowing

Mammoth clover, pounds		12
Common red clover, pounds		12
Crimson clover, pounds		15
Alsike clover, pounds		12
Alfalfa, pounds		20
Cow pea, bushels	1½	2
Soy beans, bushels	1½	2
Broad English beans, bushels	1	- 1½
Winter vetch		1

Thirteenth Census of the United States 1910

Department of Commerce, Bureau of the Census



Map Showing the Location of the Small Fruit Industry in the United States.

Summer vetch, bushels	$1\frac{1}{2}$
Canada pea, bushels	$1\frac{1}{2}$
Buckwheat, bushel	1
Rye, bushels	$1\frac{1}{2}$
Barley, bushels	$1\frac{1}{2}$- 2
Barley and peas, bushel, each	1

"The American Apple Orchard," by Waugh. Published by Orange Judd Company.

SEEDLING GROWING. See *Apple Nursery*.

SEEPAGE. See *Irrigation*.

SERVICE BERRY. See *June Berry*.

Service Tree

Sorbus domesticata

A round-headed, slow-growing tree, native of Europe, reaching a height of 50 to 65 feet. It is sometimes confounded with the ash when not in bloom, for the leaves very much resemble those of the ash, but the glutinous withered buds help to identify it. It blooms profusely, has small, whitish flowers, gathered in pinnacles at the end of the branches. It bears a pear-shaped fruit, astringent and only edible when very ripe or in a state of semi-decay. The wood is a very fine grain, solid, hard and is highly prized and much used for cabinet making, turning, wooden screws for presses, etc.

GRANVILLE LOWTHER

SETTING OF FRUITS. See p. 1059.

SIBERIAN APPLE (large). See *Apple, Botany of*.

SIBERIAN APPLE (small). See *Apple, Botany of*.

SOD MULCH. See *Apple Orchard, Cultivation of*.

Soils

The term soil is applied to that part of the surface of the earth which is stirred or tilled by implements in the process of agriculture. Below that outer stratum is the subsoil. The soil is formed by the action of the atmosphere, changes of heat and cold, frost, snows, rain, wind and other agencies which tend to pulverize the rocks, to disintegrate their masses, and to form out of them the finer particles which remain in place or are carried by the wind, water or gravitation to other situations. This outer surface is looser in texture than the subsoil. The subsoil frequently contains materials which are not favorable to the growth of crops. On this account deeper tillage than usual, which often implies what is called by farmers the subsoiling process, and which allows easier penetration of the subsoil to the surface, must always be considered. Generally the subsoiling process increases crop production. These considerations are of great importance when we reflect that directly or indirectly all food materials needed by man and beast are taken from the soil.

In addition to the process of the disintegration of rocks already named in the formation of soil, there is the process of the growth and decay of vegetable matter, such as leaves, stems, trunks, branches of trees, grasses, weeds and all kinds of vegetation, together with a slight mixture of animal substances. These, mixed together, form the principal bulk of the soil on the earth's surface, and the proportions of the ingredients of these mixtures determine largely the quality of the soil.

GRANVILLE LOWTHER

ESSENTIALS OF CROP PRODUCTION

It is essential for the proper growth of plants that they should have sufficient water, light, the proper amount of space, a suitable temperature, a suitable physical condition of the soil, and be well supplied with plant food. If any of these essentials are deficient the crop production will be deficient also, and the decrease in production will be, to a certain extent, in proportion to the deficient conditions.

Plant food is only one of the conditions which are necessary for the production of crops. The other conditions are equally important. Chemical analysis deals almost entirely with the plant food of the soil. The other conditions we have mentioned are largely conditioned by the situation of the soil, the climatic conditions which affect it, and its physical character and structure.

Plant Food.—Material which is essential to the growth of plants is termed plant food. Plants require a number of substances, but experience has shown that practically all soils contain a sufficiency of all kinds of plant food, with the exception of phosphoric acid, nitrogen and pot-

ash. The term "plant food" is often confined to these three substances which are so often needed.

Lime may also be needed by the soil, but the object of an addition of lime is to correct the acidity of the soil or to perform other functions, rather than to serve as a plant food.

The object of fertilizers is to supply phosphoric acid, nitrogen or potash in available forms, that is, in such compounds that plants can easily take up the plant food.

A soil, to be fertile, must contain plant food in such forms that plants can secure a sufficient amount of it. A soil may contain a large quantity of plant food, yet not produce good crops, because the plants cannot secure the food which it contains. We apply the term active plant food to the plant food contained in the soil in such forms that plants can easily take it up.

Physical Deficiencies of Soils

Some of the physical deficiencies of soils will here be mentioned only briefly.

The soil may be too shallow. If this is caused by rock near the surface, the soil is not suitable for cultivated crops. If caused by hardpan, it must be broken up. If caused by water, the soil may be drained. Soils in arid regions should be deeper than those in humid regions.

The soil may be too wet. If properly situated this condition may be remedied by drainage, either by ditches or by tile drains.

Porous and stiff soils are both benefited by organic matter, such as is produced by manure or green crops plowed under. Lime may improve stiff soils, making them more easily worked.

Soils which blow too easily may receive benefit from manure. A wind-break may also be of advantage.

Chemical Deficiencies

Acid soils contain an excess of acid. The remedy is to apply lime in sufficient amounts to correct the acid. Acid soils, judging from our work under way, are not found to any large extent in Texas. Definite conclusions, however, cannot be reached until further work has been done.

Alkali soils contain too much soluble salts. These consist of sulphate of soda, chloride of soda, and carbonate of soda, as a rule, but we have sometimes found calcium chloride to be present. Crops vary in their sensitiveness to alkali. Some plants will not stand much, while others will stand very large quantities. Alfalfa, when young, will not stand much alkali, but it appears to endure a large quantity when it is old and well established.

Most of the alkali which has been brought to our notice occurs in comparatively small spots, but often is very troublesome on account of its effect upon the appearance of the field in which it occurs. The remedy for alkali is underdrainage, either by means of deep ditches or tile drains.

Deficiency of Apple Plant Food

A soil cannot be productive unless it supplies the plant with sufficient food; that is, unless it contains sufficient "active" plant food. The amount of active plant food depends upon conditions surrounding the soil, as well as on the chemical and physical character. The presence of sufficient moisture, and of decaying vegetable matter, appear to aid in the maintenance of a supply of active plant food in the soil. A "run-down" soil may often be "brought up" by increasing the activity of the agencies which make inactive plant food active.

G. S. Fraps,
Chemist, Texas Agricultural Experiment Station.

COMPOSITION OF FRUIT SOILS

The percentage of essential elements of plant food in the typical soil of each of the more prominent fruit districts of the State of Washington is shown in Table I. These figures were obtained by averaging the results of all the analyses of soil samples from each of these districts which were collected during the progress of the soil survey of the state, which was conducted by the Division of Chemistry of the State Experiment Station during the years of 1893 to 1907 inclusive.

TABLE I

Composition of Soil from Typical Fruit Districts in Washington

SOIL FROM	Whitman County	Spokane Valley	Yakima Valley	Okanogan Flats	Walla Walla Valley	Wenatchee Valley
TYPE	Basaltic silt loam	Spokane gravelly loam	Yakima sandy loam	Brewster silt loam	Walla Walla sandy loam	Wenatchee sandy loam
Potash (K_2O)	0.471%	0.385%	0.455%	0.294%	0.413%	0.518%
Lime (CaO)..	0.514%	0.600%	1.154%	0.668%	1.098%	0.714%
Phosphorus pentoxide (P_2O_5)	0.361%	0.190%	0.029%	0.145%	0.142%	0.225%
Nitrogen	0.175%	0.039%	0.032%	0.062%	0.275%	0.061%
Humus	2.486%	1.410%	0.150%	1.650%	4.245%	1.942%
Total organic matter	8.733%	6.060%	1.560%	4.464%	10.741%	2.969%

These figures show the total supply of these plant food elements in the soil, determined by the official methods of soil analysis. There is, of course, no means of determining from these figures just what amounts of plant food will be available during any one growing season, i. e., what its "fertility" or productive capacity, so far as plant food is concerned, for that particular season or crop will be. However, the standards shown in Table II are often used as a basis for classifying soils with reference to their relative "richness" in plant food supplies.

TABLE II

Practical Ratings of Soils by Plant-Food Percentages According to Professor Kaeker, Halle Station, Germany

Grade of Soil	Potash	Phosphoric Acid	Lime: Clay Soil	Lime: Sandy Soil	Total Nitrogen
Poor	Below .05	Below .05	Below .10	Below .05	Below .05
Medium	.05—.15	.05—.10	.10—.25	.05—.10	.05—.10
Normal	.15—.25	.10—.15	.25—.50	.10—.20	.10—.15
Good	25—.40	.15—.25	.50-1.00	.20—.30	.15—.25
Rich	Above .40	Above .25	Above 1.00	Above .30	Above .25

Supply of Plant Food

The above facts are all presented in terms of percentage of the "fine earth" of the soil, i. e., the portion of the soil which is fine enough to serve as a source of plant food supply. If it is desired to know these same facts in terms of pounds per acre of these elements, it is easy to compute this from the weight of soil per acre. For average soils, this is about 4,000,000 pounds per acre-foot, i. e., an acre of average soil one foot deep weighs approximately 4,000,000 pounds. A soil carrying 0.417 per cent of potash would therefore have 4,000,000 by .00471, which equals 18,840 pounds of potash in each foot in depth. Computations of plant food supplies are usually made to include only the top foot of soil, as by far the greater proportion of the crops food is drawn from this part of the soil, chiefly from the tilled portion.

Available Fertility

In order that any soil shall produce the maximum crop which the moisture supply and weather conditions will permit, enough of the plant food of the soil must become available during the growing season of the crop to build up this maximum crop growth. The process by which unavailable plant food, in the form of mineral particles and partially decayed vegetable matter in the soil, becomes available to plants is essentially one of decay. Humus, or actively decaying vegetable matter, is the chief agent in making plant food soluble, or available. The problem of productivity, from the standpoint of food supply, is therefore that of keeping the processes of hu-

mus decay going on rapidly enough to make sufficient plant food available for the needs of the growing crop. In soils containing low percentages of humus, this means the plowing under of vegetable materials, such as manure, or cover crops, followed by suitable tillage to encourage the processes of decay. In soils well supplied with vegetable, or organic matter, proper tillage alone is sufficient to maintain these favorable conditions.

Plant Food Requirements of Fruit Crops

The amounts of the different plant food elements which are found, by analysis, in the mature crop are generally considered a measure of the quantity of these materials which the crop took from the soil. If there are no losses due to other sources than the growing of the crop, these amounts then represent the yearly drain upon the total food supply of the soil. Table III shows the amounts of the critical elements of fertility which are found in the indicated yield of each of some of the common fruit and garden crops.

(Taken from Van Slyke's "Fertilizers and Crops.")

TABLE III

Plant Food Requirements of Different Fruit and Vegetable Crops

Variety of Fruit	No. of Trees per acre	Nitrogen lbs.	Phosphoric Acid (P_2O_5) lbs.	Potash (K_2O) lbs.	Lime (CaO) lbs.
Apple	35	52	14	55	57
Peach	120	75	18	72	114
Pear	120	30	7	33	38
Plum	120	30	9	38	41
Kind of Vegetable	Yield per Acre				
Cabbage	10 tons	60	20	80	
Onions	300 bu.	39	15	38	
Cantaloupes	5 tons	22	8	40	
Tomatoes	250 bu.	30	11	53	
Watermelons	10 tons	34	12	60	

The figures given are, in each case, for the yield of edible material, and do not include the plant food used by the nonedible leaves, stalks, etc., it being assumed that these will be returned to the soil each year. The plant food used in making the wood growth of fruit trees is, of course, not accounted for in these calculations.

Value of Leguminous Cover Crops

Reference has been made above to the value of a sufficient supply of vegetable matter in the soil, in order that its active decay may insure an ample supply of available plant food. Humus performs many other important beneficial functions in the soil. It affects very beneficially the physical properties of the soil, increasing the ease of tilth, moisture-holding capacity, capacity to absorb heat, etc., and decreasing the tendency to "puddle" when wet and "bake" when dry.

Any farm crop which is grown for the sole purpose of plowing it under to increase the supply of organic matter in the soil is known as a "green manure." Green manures affect the soil beneficially in many ways. Some of the possible benefits are: (1) The addition of vegetable matter or "humus," with its attendant beneficial effect upon the physical and chemical properties of the soil. (2) Increasing the nitrogen content of the soil by fixation of nitrogen of the air, when leguminous crops are used as the green manure. (3) Using surplus available plant food, which might otherwise be lost. (4) Plant food from lower depths may be brought nearer to the surface and made available for subsequent crops.

The kind of crop which may best be used as a green manure depends upon which one or more of these beneficial effects is most desired. If the addition of humus, or an increased supply of decaying vegetation, is the only necessity, then

any rank-growing farm crop may be used. The more succulent or juicy plants are best, as they decay much more quickly and are more easily incorporated in the soil. If, however, the supply of nitrogen in the soil is small and its increase is either the chief necessity or a desirable addition to the increased humus content, then some leguminous crop must be used, as no other farm crop has the power of utilizing atmospheric nitrogen or of returning to the soil any essential element of fertility which it did not draw from it. If it is desired to bring up from below some of the mineral plant food which is present in deeper layers of soil, then a deep-rooting crop should be used.

Legumes as Green Manure

The legumes, or leguminous crops, are a group of plants which are characterized by growing their seed in pods and by having peculiar knots or nodules on their roots. These nodules are formed by the action of a certain group of bacteria, immense numbers of which are found in each nodule, which have the peculiar property of being able to use the gaseous nitrogen of the air for their own growth, and supplying this element as they die and decay to the host plant on whose roots they are located. Included in this group are alfalfa, all the clovers, vetches, peas, beans, etc. No other group of plants or animals, so far as is now known, is thus able to make use of atmospheric nitrogen. Legumes may grow in soils which are rich in available nitrogen without the presence of the nodule-producing bacteria, deriving their nitrogen supply directly from the soil as do other crops, but have the distinctive power of being able to flourish in soils poor in nitrogen if the proper bacteria are present to grow upon their roots and supply them with nitrogen from the air, and when so grown to increase the supply of soil nitrogen when plowed under as green manures.

The amount of actual gain in nitrogen to the soil from the growing of leguminous cover crops depends upon several factors, such as: (1) the kind of crop used; (2) the amount of nitrogen already present in the soil, as this affects the proportion of nitrogen which the crop will take from the air, and (3) the proportion of the crop which is returned to the soil.

Nitrogen Content of Different Legumes

Analyses have been made by the writer in the laboratory of the State Experiment Station of the different parts of various leguminous crops—the samples being taken from adjacent plots where each legume was given equal conditions of soil, moisture-supply, etc., for its growth. The results of some of these analyses are shown in Table IV.

TABLE IV

Nitrogen Content of Different Legumes

CROP	Per Cent Nitrogen in Dry Matter			
	Tops	Roots	Nodules	Whole Plant
Tangier Pea	3.63	2.47	4.00	3.50
Field Pea....	2.68	2.38	2.84	2.62
Spring Vetch.	2.61	2.54	5.09	2.58
Hairy Vetch.	2.96	2.45	5.07	2.80
Alfalfa	1.72	1.27	6.92	1.50
Red Clover..	2.30	1.91	5.97	2.18
White Clover.	1.87	1.73	5.86	1.82

As has been pointed out, the proportion of this nitrogen which the crop will gather from the air, through its bacteria, depends upon the supply of available nitrogen present in the soil. On average soils, with a generous supply of nodules developing on their root systems, it is estimated that about one-fifth the total nitrogen content of the crop comes from the soil and the other four-fifths from the atmosphere.

If the tops, or foliage growth, of the

crop is cut off and removed from the land, the gain in nitrogen to the soil is slight if any. It is generally estimated that for most common forage crops, the dry matter in the root system constitutes about one-fifth, and the above-ground portion four-fifths of the total growth. By comparing this statement with that in the preceding paragraph, it will be seen that, under ordinary conditions, the amount of nitrogen returned to the soil by the decay of the roots only of the crop would be just equal to the proportion of the crop's total supply which originally came from the soil. If, however, the tops, as pasturage, soiling crop, or hay, are fed to live stock and the manure therefrom returned to the land to be plowed under, nearly ninety per cent of the total nitrogen of the crop will be restored to the soil.

If the entire crop is plowed under, all of the nitrogen which it contains is restored to the soil, and as the crop decays, becomes available to succeeding crops.

Gain of Nitrogen per Acre and Market Value

The gain of nitrogen per acre to the soil if any one of these crops be plowed under as a green manure may be calculated by multiplying the percentage of nitrogen in the whole plant by the weight of dry matter produced on an acre. This weight of growth will, of course, vary extremely in different seasons, on different soils, and with different cultivation. Table V shows examples of possible gains which may be made, computed from the yields per acre as given. The present market value of nitrogen in commercial fertilizers as sold in this state is about twenty cents per pound. The market value of the gain in nitrogen per acre by plowing under the average crop as shown is indicated in the last column.

TABLE V

Gains in Nitrogen by Plowing Crops Under

CROP	Nitrogen per ton, lbs.	Probable yield per acre, tons	Nitrogen gain per acre, lbs.	Market Value of gain in Nitrogen
Red Clover	43	3	129	$25.80
Alfalfa	30	3	90	18.00
Field Peas	52	4	208	40.16
Tangier Peas	70	3	210	42.00
Hairy Vetch	56	4	224	44.80

It is probable that the yields assumed in this table are higher than could be obtained in actual field practice. Certainly they are larger than would be obtained in the dryer sections of the state. They are not larger, however, than may be secured under irrigation, or in those parts of the state where the annual rainfall is heavy. Not all of the nitrogen shown as gain, in the above table, would be net gain in every instance. On soils rich in nitrogen, the crop takes only a part of its nitrogen from the air, securing a considerable proportion from the soil itself. Probably, the poorer the soil is in nitrogen, the greater the proportionate gain in nitrogen from the air. The net gain is, therefore, likely to be greatest in those soils which are in greatest need of nitrogen.

R. W. Thatcher,
Director Wash. Experiment Station.

A BALANCED CHEMICAL COMPOUND IN THE SOIL

We know what it means to have a balanced ration of human food. No matter how good an article of food may be, if the individual is compelled to eat that and nothing else he not only tires of it, but it is impossible for him to maintain on that food alone a good degree of health. Perhaps the food that contains more of all the nutritive substances than any other is whole wheat or Irish potatoes, but

there is no single article of human food that is sufficient of itself.

This has been discovered to be true in the feeding of stock as well as in the preparation of human food, and it is a common remark among the breeders of poultry that chickens, in order to lay large quantities of eggs, must have a balanced ration.

This seems to be a law that runs through all nature, and it is equally true in vegetable as it is in animal life. The vegetable gets its food mainly from the soil, and it is known that clay is a fertilizer for sandy loam. Sand will also fertilize a clay soil, a boggy soil, a gumbo or an adobe soil; and in turn the boggy soil will fertilize the sand or the clays of the upland. A soil rich in humus will fertilize both sand and clay. Wood ashes is an excellent fertilizer for apple orchards, and alkali is a fertilizer for soils deficient in the alkali substances. Alkali is a fertilizer up to a certain degree, when it becomes injurious.

The proper balance of food substances for the different kinds of vegetables and fruits may be hard to determine, but in the ability to do this lies the difference between the ordinary farmer and the one who succeeds in the highest degree.

GRANVILLE LOWTHER

Influence of Alkali on the Germination and Growth of Plants

In experiments by the Wyoming station on the influence of alkali salts on the germination of wheat and rye it was found that small amounts of these salts hasten germination and no doubt also "assist in the life of the plant, either stimulating its growth or acting directly as plant food." When, however, the proportion of alkali salts exceeded certain limits, germination was interfered with.

*Plants Adapted to Alkali Soils

Throughout the western portion of the United States, especially where irrigation is practiced, areas of alkali soils of greater or less extent are of frequent occurrence. These soils derive their name from the fact that they are strongly impregnated with soluble salts, which effloresce or "bloom out" in the form of a powder or crust during dry weather following rains or irrigation. The basis of these salts is mainly soda, together with smaller amounts of potash and usually a little lime and magnesia. They are mixtures chiefly of sodium sulphate, sodium chloride (common salt), and sodium carbonate in varying proportions. They often contain in addition small amounts of potassium sulphate, sodium phosphate, and sodium nitrate, substances whose fertilizing value is well known.

Of the different forms of alkali, that in which sodium carbonate predominates (black alkali) is by far the most injurious to vegetable growth and to the tilling qualities of the soil; common salt (sodium chloride) ranks next in injuriousness; while sodium sulphate is the least injurious.

While the occurrence of alkali in excess in the soil constitutes a serious menace to the successful production of most farm crops, recent investigations have shown that there are many plants of economic value which are able to tolerate a considerable amount of alkali. The investigations of the California station have shown that the resistance to alkali varies greatly with the kind of plant and the character of the salts in the alkali.

Thus the plants of the goosefoot family, comprehending, besides the goosefoot proper, the beet, spinach, samphire, saltwort and the salt bushes generally, will resist very large amounts of all three of the salts; while, on the other extreme, the legumes—clovers, peas, beans, vetches, etc.—resent even small amounts of either. The entire sunflower family is rather tolerant of alkali, while most of the cultivated grasses proper are quite sensitive, if only because their shallow rooting exposes them peculiarly to the evil effects of the surface accumulation of alkali by evaporation.

* See also United States Department of Agriculture Farmers' Bulletins 92, page 5; 267, page 14

United States Department of Agriculture, Office of Experiment Stations

Highest Concentration of Alkali Harmless to Various Forms of Vegetation

The following table, prepared by Professor Hilgard, gives a fair idea of the relative resistances of various crops. The information was gathered under certain conditions, but experience shows the relations are generally true. One or two exceptions have been noted in several Westerns states, viz., corn, which appears at the end of Professor Hilgard's list, has shown itself to be more resistant than alfalfa and the grains, and grapes have withstood conditions that drove alfalfa and sugar beets from the field.

(Pounds of sodium per acre in four foot depth.)

Forms of Vegetation	Total Alkali	Sodium Sulphate	Sodium Chloride	Sodium Carbonate
Salt grass....	136,000	14,200	27,700	59,200
Salt bush....	56,000	40,700	49,300	8,160
Alfalfa, old..	39,400	33,200	.....	1,020
Alfalfa, young	4,690	3,600	.....	1,020
Sorghum	29,100	20,000	3,810	4,110
Radish	22,500	16,800	880	3,780
Sugar beet...	21,400	17,000	4,030	1,740
Sunflower ...	21,400	17,000	2,140	760
Grapes	16,300	13,200	3,790	3,280
Onions	13,700	.....	2,290	.....
Potatoes	13,700	.....	2,290	.....
Carrots	10,200	8,050	930	540
Figs	9,430	7,920	320	486
Almonds	9,130	7,350	940	630
Barley	9,120	3,890	2,000	5,280
Pears	7,480	5,760	540	760
Wheat	6,170	4,900	456	640
Apples	5,760	4,610	488	278
Celery	4,890	1,320	3,780	.....
Rye	4,460	3,170	680	417
Prunes	4,220	2,990	472	590
Peaches	4,030	3,110	393	295
Apricots	3,600	2,800	378	208
Sweet corn..	.....	.....	.....	780

By reference to the above table it is seen that in some instances the amount of total salts which a plant will withstand is greater than the sum of the three component quantities. The reason for this is that the salts operate against one another and neutralize the respective actions.

R. A. Hart,
United States Drainage Engineer.

TRUCK AND FRUIT SOILS

Early Truck and Potato Soils

To grow market-garden crops in a satisfactory manner and to get them in the market early enough to warrant a good price, one needs a notably warm soil. The better types of this class of soil usually contain relatively large amounts of sand and small amounts of clay. Snyder, whose discussion of this matter is being followed in this particular portion of this article, suggests that the better types of early truck and potato soils are apt to contain about 60 per cent of medium sand, from 20 to 25 per cent of silt, perhaps about 5 per cent of clay, and that, when carrying 3 per cent of silt, they hold from 5 to 12 per cent of water. He points out that when these crops are grown on soils containing much more water than this, they are apt to be slow in maturing. When used for the production of early market-garden crops, and as one gets further north, the proportion of sand may relatively increase, and of silt decrease. Soils like this are not apt to be naturally as rich in plant food as are some of the other types, but are of a nature to make admirable use of large quantities of added plant food.

General Truck and Fruit Soils

Where extreme earliness is not a factor, and where water constitutes a large percentage of the market crop, as in market-garden crops and fruit, more of clay, rather less of sand and, consequently, a greater water-holding capacity are to be desired than when early truck is grown. From 10 to 15 per cent of clay, 50 per cent of sand, and 10 to 18 per cent of water are preferred. Great divergence of practice is observed, particularly in the growth of fruit. Some fruits succeed admirably on soils with a large percentage of clay; others on soils such as those now under consideration.

EFFECT OF MULCHES OF DIFFERENT DEPTH IN CONSERVING SOIL MOISTURE

The purpose of the soil mulch is to break, as completely as possible, the capillary connection by means of which the soil moisture moves upward, and to protect the moist soil below from the rapid evaporating effect of moving air. No mulch can accomplish these results perfectly and prevent all loss by evaporation. Since the mulch, being dry soil, in which plant roots cannot grow, is just that much lost soil so far as furnishing plant food is concerned, it ought not to be any deeper than is necessary to conserve the largest

possible proportion of soil moisture. This depth will vary with different types of soil. Professor Thom, soil physicist of the Washington State Experiment Station, working with the ordinary "volcanic ash" soil of the Palouse regions, found the following effect of mulches of different depths upon the loss of soil moisture from the soil during the month of August, 1912:

Table VI

Effect of Depth of Mulch Upon Evaporation of Soil Moisture

Depth of mulch.	Moisture loss, calculated as to acre-inches.
No mulch	1.66
1 inch	1.42
2 inches	1.15
3 inches	1.02
4 inches	1.01
5 inches	.98

These results show that while mulches deeper than three inches save slightly more moisture, the saving is too little to compensate for the additional loss of plant food supply. Similar results have been reported from measurements made by the United States irrigation investigations on irrigated lands in California, where it was found that a three-inch mulch saved 72 per cent of the total possible saving and that increasing the depth of the mulch to ten inches only resulted in a saving of 88 per cent of the total possible amount. For all ordinary soils and conditions, therefore, a three-inch mulch is the most efficient depth.

R. W. THATCHER,
Director Washington Experiment Station.

RAPIDITY OF RISE OF CAPILLARY MOISTURE IN DIFFERENT TYPES OF SOIL

The rate at which water rises through soil by capillary action depends upon the size of the soil particles and the proportion of humus which the soil contains. In an experiment conducted by Prof. C. C. Thom, soil physicist of the experiment station at Pullman, Washington, the following results were obtained. The different soils were placed in large galvanized iron tanks in the open field, all equally compacted, and a constant supply of water fed to each at a depth of two feet below the surface. The amount of water, expressed both in pounds and in the equivalent acre-inches, which came up through the soils and evaporated away into the air during the month of August, 1912, is shown in the following table:

Table VII

Rate of Capillary Rise of Water in Soil, as Shown by Evaporation Losses

Kind of Soil	Loss in lbs.	Loss, as acre-ins.
Sand	33.3	2.19
Loam	26.2	1.66
Clay	24.0	1.53
Humus	18.4	1.17

R. W. THATCHER,
Director Washington Experiment Station.

PROBLEMS IN SOIL FERTILITY IN WESTERN WASHINGTON

From all over Western Washington farmers are constantly inquiring "What fertilizer shall I put on my soil to make it grow vegetables, grasses, or fruit?" or "Will you please analyze my soil and tell me what element it lacks, or what element it contains?" These inquiries show a very general need for information as to how food elements exist in the soil and how fertility may be developed within the soil.

All agricultural plants require for their growth thirteen elements, all of which are found in greater or less quantity in every soil that will grow plants at all. Of these elements the only ones apt to be deficient in any soil are nitrogen, potash, phosphoric acid, and sometimes lime. Physically, all soils consist of broken down rock and decaying organic matter (the remains of leaves, stems, roots, manure, etc.). The plant must derive its potash, phosphoric acid and lime from the broken down rock of the soil. The nitrogen needed by the plant is secured from the decaying organic matter of the soil, except in the case of leguminous plants, which are able to secure some of the free nitrogen of the air through the action of certain bacteria on their roots.

How do the plants take up these elements? Pour water through a bucket of good soil; it will come through discolored. Chemical analysis will show that the water has dissolved certain compounds of potash, of phosphorus, and of nitrogen (as well as compounds of other elements) from the soil. This solution of compounds

of elements is taken up by the plant root hairs in contact with the soil particles and serves as plant food. If we continued to pour water through our bucket of soil we should soon discover that we had practically exhausted the soluble material in the soil. Examination of the soil from a vigorous growing, well cultivated crop in July or August would also show that the immediately soluble material in the soil would supply the growing plants only a few weeks at best—not nearly enough to last through the growing season.

How, then, is the growing plant to be kept in food? If the bucket of soil from which you washed practically all the soluble material be set aside for a few days and be kept nicely moist it will be found you are again able to dissolve considerable material from the soil. Certain chemical changes have been going on in the bucket of soil that have changed a small amount of the insoluble material into soluble form. These same chemical changes take place in the field under suitable conditions, but the rapidity of the changes will vary markedly with variations in the necessary conditions.

The secret of successful soil management rests in keeping the conditions right for the liberation of as much food as a bumper crop can use—no more, no less.

If the soil is managed so that considerably more of the important elements are made soluble than the crop can use, the surplus will be washed away to a large extent and the soil will be rapidly depleted of its latent or reserve fertility. If less than enough to support a maximum crop is made available, the legitimate profits of soil tillage are directly reduced, or, as is true in many cases, the receipts do not pay the cost of operation.

Necessary Conditions—Air

1. The proper circulation of air in the soil. Oxygen of the air helps to break down the hard rock material in the soil much as it changes the hard, shiny surface of a plowshare to a powder (rust) in the presence of moisture. Without oxygen plant roots will die. Oxygen taken in by the leaves will not take the place of oxygen needed by the roots.

Many of the desirable chemical changes in the soil are due to the action of soil bacteria with which all healthy soils are teeming. These bacteria cannot thrive without oxygen. Just to the extent that the full amount needed is reduced will the desirable bacterial action be reduced. There cannot be proper circulation of air in a soil well filled with stagnant water, nor can there be proper circulation of air in a field packed hard and dried into brick-like clods. We recognize by the growth on such soils that something is wrong.

Humus

2. A good supply of organic matter. This furnishes food for soil bacteria. Through their action the organic matter decomposes, and weak acids are formed, which attack and dissolve the rock material, putting it into available form for the plants. With a deficiency in organic matter there will not be enough acids formed to liberate the desired amount of mineral elements. A variation in the amount and rapidity of decomposition of the organic matter will also cause corresponding variation in the supply of available nitrogen for the plant. Deficiency of nitrogen and need for more organic matter is readily recognized by the light yellowish color of growing vegetation, while an abundant supply is recognized by the rich, dark-green, luxuriant foliage. Note difference in color after the application of barnyard manure or the plowing under of a clover sod.

The organic matter makes heavy soils more friable and easy to work, and less likely to puddle and bake, and opens them up so they will take water and air better. It partially fills the pores of loose, sandy and gravelly soils, making them more compact, increasing their power to hold water and soluble plant food, lessening the danger in a wet climate, or, under irrigation, of leaching away of available plant food.

Moisture

3. A proper supply of capillary moisture. Water alone has a very gradual solvent action on the rock material, but it is as essential in keeping up healthy bacterial action in the soil as it is to a

milch cow. Furthermore, plants cannot take up soluble plant food from the soil without it is first dissolved in capillary moisture. A loose, cloddy, dry seed bed then will not furnish the best conditions for the rapid development of soluble plant food, no matter how full of straw and air it may be. It must be worked down thoroughly to hold the moisture.

Proper Temperature

4. Bacterial action and chemical changes progress very slowly with a soil temperature lower than 55 degrees. The temperature varies considerable with the kind of soil, the amount of water present, the color and amount of organic matter present and the tillage. Sandy soils are well known to be earlier and quicker growers than heavy soils. This is because they are warmer.

A poorly drained soil will often be 10 to 15 degrees colder than a similar soil well drained. This is equivalent to putting the crops behind about one month. The yellowish color of plants growing in poorly drained spots in a field are ready evidence of retarded bacterial action in the soil.

Experiments have shown that the supplying of an abundance of organic matter may sometimes make a difference of one or two degrees in field culture. This is a hotbed effect, only much reduced in intensity.

In the development of available plant food in the soil these four factors just enumerated are equally essential: proper circulation of air, plentiful supply of organic matter, good supply of capillary moisture, and a suitable temperature. Translating these needs of the soil into farm operations, what shall the Western Washington farmer do to provide these conditions?

Take Off Surplus Water

1. Provide thorough underdrainage wherever water will collect in a hole within four feet of the surface during the growing season. Quite a large percentage of the farming lands of Western Washington need underdrainage badly, and will never give thoroughly good results until it is provided. Many soils that are now being tilled with moderate profit would do much better if underdrained. In many cases a more profitable kind of crop could be grown.

Thorough drainage will ultimately make the soil warmer and earlier and more friable and easy to work, and the period during which it may be tilled will be greatly extended.

Plow, Harrow and Disk

2. Thorough tillage, including deep plowing, thorough cultivation of the entire furrow slice, and thorough surface tillage through the growing season, where possible, is essential in order to hold the moisture and destroy weeds.

A healthy plant develops a very large root system compared to the top of the plant, develops it very rapidly and in all directions. With ordinary crops every cubic inch of soil to the depth of four feet will be penetrated with fine roots before the plants have made their growth, if the soil is in condition for such development. The magnitude of the portion above the ground, in other words "the drop," will depend upon the freedom with which the roots may develop and the completeness with which they may occupy the soil. The feeding capacity of the plant varies with the extent of its root system. The seed bed should come into the homogeneous condition of a nice bowl of granulated sugar, where a delicate root would find practically no resistance to development in any direction, yet would come into contact with soil particles on every side.

Vetch, Clover and Peas

3. Keeping a supply of humus in the soil may be accomplished in two general ways:

(1). In general farming, the plowing under of a good clover or grass sod every four or five years will usually keep the soil well supplied with organic matter. Many instances are found in the older states where worn-out soils have been brought into a high state of fertility by thorough tillage and the judicious use of clover in a rotation, without the introduction of any outside source of fertility

whatever. The growing of peas and vetches aids greatly in keeping up the fertility of the soil, but will not add to the humus supply of the soil like a clover sod, unless the tops are plowed in.

Where the system of farming does not include the growing of a biennial or perennial crop, like clover and grasses, some quick-growing crop must be plowed in occasionally. Rye or vetches, sown in the fall after an early crop is removed, will be ready to plow under for a late spring crop. In almost any system a humus-producing crop may be sandwiched in somewhere occasionally.

(2). By the use of barnyard manure. This is preeminently the best means for keeping soil in a high state of fertility. In all countries and in all localities where dairying has become well established and where thorough tillage has accompanied the use of the manure, high average yields are secured, and nothing will operate faster for the building up of Western Washington soils than the development of the dairy industry, accompanied with careful saving and use of the manure produced.

Excellent examples are scattered all over Western Washington, showing that conformity to the foregoing principles will bring the majority of our Western Washington soils into a very high state of fertility. Nearly all our soil contains stored plant food enough for a great many bumper crops.

George Severance,

Superintendent Western Washington Experiment Station, Puyallup, Washington

HEAT AND SOIL FERTILITY

The Rothamsted experiments have recently thrown great light on the earlier known fact that heating the soil, thus accomplishing something approaching sterilization, results in a heightening of the "fertility" of the soil. The experiences of Stone of Amherst and others show that the general fact has come under observation. The experience that carbon bisulfid used for killing the Phylloxera increases the growth of the vines, even though the Phylloxera was not previously present, and the practice of the ancients of "firing" the soil, are other examples.

The reason for this is that heating the soils may improve their fertility. It appears that, in addition to the bacteria in the soil which have to do with the preparation of those nitrogenous substances which can be taken up by the plant, there are numerous animal forms called protozoa, similar to the white corpuscles or phagocytes of the blood. As these destroy bacteria which gain entrance to the body through wounds, so the protozoan forms in the soil devour and thus destroy the bacteria which are so useful in the preparation of materials for the plant. If, therefore, there are many protozoa in the soil this will be a poor soil, since the bacteria are destroyed. Heating may be arranged so as to destroy all the protozoa, and, while the numbers of bacteria are reduced, they may not be totally destroyed. Thus, the bacteria remain to start afresh the nitrifying processes, and their recovery and multiplication is very rapid. In this way the "fertility" of a soil treated is very much increased.

It will appear that the method of heating the soil by steam will be of great practical importance, especially in greenhouses and hotbeds and cold frames in which vegetables and seedlings are raised.

EXTENT OF SOIL EROSION IN THE UNITED STATES

Investigations by the United States Geological Survey of the erosion of numerous drainage basins of the United States show that the surface of the country is being removed at the average rate of about an inch in 760 years. Though this amount seems trivial when spread over the surface of the country, it becomes stupendous when considered as a total, or even in separate drainage basins. Mississippi river, for instance, carries annually to the sea 136,400,000 tons of dissolved matter and 340,500,000 tons of suspended matter, and of this total Ohio river carries 83,350,000 tons and Missouri river contributes more than twice as much. Colorado river, which has built up for itself a vast

delta, brings down more suspended matter than any other river in the United States, delivering annually 387 tons for each square mile of its drainage basin, or a total of 100,740,000 tons.

The rivers of the United States carry to tidewater every year 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter. This total of 783,000,000 tons represents more than 350,000,000 cubic yards of rock, or 610,000,000 cubic yards of surface soil. If this erosive action had been concentrated on the Isthmus of Panama at the time of American occupation it would have excavated the prism for an 85-foot level canal in about 73 days.

GEO. OTIS SMITH.
Director United States Geological Survey.

South Carolina

South Carolina has 33,393 square miles of area. The drainage system is towards the southeast, into the Atlantic ocean. There are a number of harbors along the Atlantic coast, the principal of which is Charleston. The Savannah river is navigable for the most part along the border of South Carolina, and furnishes cheap transportation to the ocean.

Geologically, South Carolina is divided into ezoic, silurian, tertiary, quartenary and cretaceous formations. Along the rivers there are cretaceous formations; the level pine lands and coast lands belong mostly to the tertiary and quarternary age, and the upper hill lands to the ezoic and silurian.

Physically it is divided into the "red sand hill region," the "Piedmont region," and the "Alpine region." The red sand hill region borders on the coast, and contains a number of fertile islands. This region is adapted to certain kinds of horticulture, such as the growing of figs, grapes, peaches, plums, pecans, almonds and, in particularly favored places along the coast, oranges and olives. Vegetable growing is an important industry here, and cabbages, peas, beans, asparagus, Irish potatoes, sweet potatoes and other vegetables are grown with profit, and find a ready market. On account of the near access to the coast and to the Savannah river, which is navigable for most of the distance along the southeastern border of the state, transportation is easy and inexpensive.

The Piedmont region is sometimes called the pine belt. Strawberries, grapes, peaches, plums and the earlier varieties of apples may be grown successfully. This region is also noted for the growing of watermelons, cantaloupes, asparagus, potatoes and sweet potatoes. Here sweet potatoes reach a high state of perfection, and from 400 to 600 bushels are often grown on one acre of land.

The Alpine region rises to a height of 3,000 feet above the sea, and Table mountain, one of its peaks, rises to a height of 4,000 feet. It is on account of the elevation that it is possible to grow winter apples in this region. For the varieties that will succeed best, see *Varieties Recommended for Planting*, page 192.

The grapes grown in this region are of superior quality, and the Delaware, Concord and Niagara are practically free from diseases that affect them in other sections.

The fruit industry in the hill sections has not reached a high state of development, yet nature has given to this country advantages which make an extensive and profitable horticulture possible. They are farther from markets, and the transportation is not so easy as in the lower sections, but the fine quality of the fruit will compensate for these disadvantages, and it will doubtless become an important fruit-growing section.

GRANVILLE LOWTHER

Frost and Precipitation in South Carolina

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Clemson Col.	Oct. 31	April 6	Oct. 15	April 20	51.2
Greenville	Nov. 6	April 5	Oct. 23	April 25	53.0
Santuck	Oct. 29	April 7	Sept. 30	April 30	48.0
Society Hill	Nov. 15	Mar. 18	Oct. 27	April 4	49.1
Columbia	Nov. 8	Mar. 23	Oct. 19	April 10	46.7
Stateburg	Nov. 14	Mar. 29	Oct. 27	April 9	44.4
Trenton	Nov. 11	Mar. 21	Oct. 25	April 13	52.1
Aiken	Nov. 20	Mar. 11	Oct. 28	April 9	48.9
Blackville	Nov. 17	Mar. 13	Nov. 8	Mar. 23	48.4
Trial	Nov. 5	April 4	Oct. 10	April 28	50.5
Charleston	Nov. 30	Mar. 3	Nov. 9	April 2	53.4
Beufort	Nov. 28	Mar. 8	Nov. 7	April 1	48.3

Production of Fruits in South Carolina

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	..	856	591	1,408,099	$113,254
Strawberries	1,383	815	499	1,337,208	108,938
Blackberries and dewberries	675	38	39	64,754	3,710
Raspberries and loganberries	79	2	4	4,955	477
Currants	30	1	2	999	102
Gooseberries	5	(1)	(2)	183	27
Other berries		.	47		.

[1] Reported in small fractions. [2] Less than 1 acre.

Strawberries are by far the most important of the small fruits raised in South Carolina. The total acreage of small fruits in 1909 was 856, as compared with 591 in 1899, an increase of 44.8 per cent. The production in 1909 was 1,408,000 quarts, as compared with 959,000 quarts in 1899, and the value was $113,254 in 1909, as compared with $59,486 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 1,133,000 bushels, valued at $956,000. Peaches and nectarines contributed considerably more than one-half of this quantity, and apples most of the remainder. The production of grapes in 1909 amounted to 2,016,506 pounds, valued at $88,620; that of nuts to 376,013 pounds, valued at $26,888; while the tropical fruits produced were valued at $49,778.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	...	2,169,986	...	723,892	1,132,668	$956,376	432,173
Apples	40,425	581,767	20,689	269,044	362,800	276,410	251,728
Peaches and nectarines	49,935	1,336,142	20,523	349,790	643,040	557,303	129,472
Pears	17,261	105,251	10,899	54,732	65,680	67,685	20,439
Plums and prunes	10,455	82,212	3,715	21,657	48,754	37,555	16,177
Cherries	10,685	60,274	4,329	25,764	10,987	15,880	6,551
Apricots	919	1,916	605	1,463	504	620	120
Quinces	775	2,002	434	1,205	534	587	(2)
Mulberries	35	422	14	237	369	336	(2)
Unclassified	...	...	...	...	...	...	[3] 7,686
Grapes	12,239	79,708	4,431	19,704	2,016,506	88,620	3,323,835
Nuts, total		[4] 38,743	...	[4] 48,124	[4] 376,013	[4] 26,888	213,320
Persian or English walnuts	473	1,373	526	1,834	28,160	2,583	1,500
Pecans	1,556	33,366	2,888	43,639	159,823	20,442	13,020
Black walnuts	986	3,662	645	2,258	185,252	3,672	(2)
Unclassified		...	...		...	...	[3] 198,800
Tropical Fruits, total		[5] 25,033	...	[5] 7,506	...	[5] 49,778	...
Figs	9,938	24,807	2,466	7,325	975,136	49,169	74,050

[1] Expressed in bushels for orchard fruits and in pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes hickory nuts, chinquapins, chestnuts, Japanese chestnuts, Japanese walnuts, hazelnuts, almonds, Brazil nuts, butternuts and other nuts.
[5] Includes oranges, lemons, pomeloes (grapefruit), pomegranates and Japanese persimmons.

The production of all orchard fruits together in 1909 was 162.1 per cent more in quantity than that in 1899, while the production of grapes decreased materially. The value of orchard fruits increased from $273,000 in 1899 to $956,000 in 1909, and that of grapes from $82,706 in 1899 to $88,620 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule:

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	249	0.1	Gals.	6,692	18,112
Vinegar	399	0.2	Gals.	3,599	8,159
Wine and grape juice	888	0.5	Gals.	12,371	14,187
Dried fruits	647	0.4	Lbs.	26,758	21,140

South Dakota

South Dakota has great extremes of altitude for a country that is generally called a "Plains Country." The Big Stone lake, in the northeastern part, is its lowest point, 1,000 feet above the sea. The Black Hills, in the southwestern part, rise to a height of 8,000 feet. There are narrow canyons, broad valleys, and high, rolling prairies; there are areas where a stone can scarcely be found within a square mile, and others where the surface is almost covered with rocks.

The average amount of rainfall in the state is 20 inches, ranging from 13.9 at Ashcroft to 25.9 at Aberdeen. The tem-

perature, in its known extremes, ranges from 46 below zero to 111 above. There are places where irrigation is carried on to considerable extent, notably in the Black Hills region, where the water is supplied by the North Fork and South Fork of the Cheyenne river, and in certain districts where the water is supplied from artesian wells, that furnish abundant supply and good pressure at small cost. GRANVILLE LOWTHER

South Dakota is not a great fruit-producing country. The following from the United States Census Reports will give a pretty good idea of its relative importance in horticulture:

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	....	419	161	401,295	$47,263
Strawberries	1,836	226	62	238,164	26,764
Blackberries and dewberries	112	5	5	6,058	809
Raspberries and loganberries	519	66	21	60,285	8,703
Currants	1,448	67	38	52,951	6,021
Gooseberries	1,271	55	25	43,408	4,926
Cranberries	7	(1)	1	288	25
Other berries	3	(1)	9	141	15

1 Reported in small fractions.

Strawberries are by far the most important of the small fruits raised in South Dakota, with raspberries and loganberries ranking next. The production in 1909 was 401,000 quarts, as compared with 166,000 quarts in 1899, and the value $47,263, as compared with $16,629.

Orchard fruits, grapes and nuts: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 230,000 bushels, valued at $209,000. Apples contributed about five-sixths of this quantity, plums and prunes most of the remainder. The production of grapes in 1909 was 144,634 pounds, valued at $4,789, and that of nuts 73,715 pounds, valued at $1,511.

The production of all orchard fruits together in 1909 was nearly nine times as great in quantity as that in 1899, and the production of grapes also increased very rapidly. The total value of orchard fruits increased from $29,568 in 1899 to $209,339 in 1909, and that of grapes from $2,158 in 1899 to $4,789 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	.....	599,586	....	721,924	229,907	$209,339	26,401
Apples	9,316	274,862	13,510	460,547	191,784	158,729	17,121
Peaches and nectarines	85	1,815	325	5,259	148	167	13
Pears	216	1,844	685	5,087	162	447	157
Plums and prunes	6,266	268,268	7,960	172,186	31,748	36,872	8,114
Cherries	4,144	51,613	7,097	76,293	5,924	12,981	900
Apricots	28	144	113	856	13	12	....
Quinces	9	141	36	978	8	8	(2)
Mulberries	28	899	18	718	120	123	(2)
Unclassified	....	....	....	....	....	....	[3] 96
Grapes	968	38,647	1,532	46,891	144,634	4,789	16,061
Nuts, total	....	[4] 18,490	....	[4] 10,608	[4] 73,715	[4] 1,511	14,200
Black walnuts	311	16,726	252	10,219	72,659	1,490	(2)
Unclassified	....	....	....	....	....	....	[3] 14,200

[1] Expressed in bushels for orchard fruits, and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes almonds, pecans, butternuts, hazelnuts, chestnuts, hickory nuts and other nuts.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedules:

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	52	0.1	Gals.	4,103	6,458
Vinegar	39	0.1	Gals.	2,823	3,622
Wine and grape juice	153	0.2	Gals.	10,096	5,593
Dried fruits	32	(1)	Lbs.	1,247	....

[1] Less than one-tenth of 1 per cent.

Frost and Precipitation in South Dakota

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Ashcroft	Sept. 10	May 22	Aug. 27	June 20	14.0
Bowdle	Sept. 16	May 19	Sept. 8	June 20	18.5
Aberdeen	Sept. 10	May 23	Aug. 23	June 21	25.9
Millbank	Sept. 23	May 18	Sept. 11	June 11	20.6
Spearfish	Sept. 27	May 4	Sept. 11	June 21	21.8
Cherry Creek	Sept. 20	May 25	Sept. 7	June 26	13.3
Pierre	Sept. 30	April 29	Sept. 12	May 19	16.7
Redfield	Sept. 18	May 21	Sept. 10	June 21	20.5
Gary	Sept. 17	May 18	Aug. 23	June 28	22.7
Huron	Sept. 18	May 14	Aug. 23	June 21	20.5
Brookings	Sept. 12	May 23	Aug. 23	June 22	19.5
Rapid City	Sept. 20	May 1	Sept. 13	May 20	16.2
Hotch City	Sept. 20	May 16	Sept. 12	June 21	15.0
Kimball	Sept. 27	May 6	Sept. 12	May 30	18.9
Alexandria	Sept. 14	May 16	Aug. 23	June 21	24.6
Sioux Falls	Sept. 17	May 10	Aug. 23	May 25	24.2
Oelrichs	Sept. 20	May 10	Sept. 9	May 27	19.3
Rosebud	Sept. 22	May 11	Sept. 10	May 30	18.3
Greenwood	Sept. 24	April 27	Sept. 12	May 20	23.0
Tindall	Sept. 23	May 6	Aug. 23	May 30	22.8

SOUTHERN APPLE. See *Apple, Botany of.*

Spinach or Spinage

Spinacia oleracea.

A garden annual pot herb of the goosefoot family. The plant has a hollow stem about two feet high, with large, thick deep-green leaves, somewhat triangular in shape. It is probably of Persian origin, having been introduced into Europe about the middle of the 15th century.

It should be grown on good ground, well worked and manured, and for the summer crops abundant water will be necessary. The first sowing of winter spinach should be made early in August and another toward the end of the month, in some sheltered but not shaded situation, in rows 18 inches apart, the plants as they advance being thinned and the ground hoed. By the beginning of winter the outer leaves will have become fit for use, and if the weather is mild, successive gatherings may be obtained up to the beginning of May, provided the winters are not too severe, or provided the plants are covered with a coating of hay, straw or leaves.

Spring sowing for summer use may be early, and between early peas, cabbages, potatoes, or other slow-growing crops; or there may be a succession of sowings during the season, about two weeks apart. They will be ready for table use about six weeks from the time of planting.

Spinach is very hardy, and not difficult to cultivate, but requires a very rich soil to get the best results.

Varieties

There are several varieties, differing in their qualities of hardiness, succulence and times of maturity. Among the best in common use in the United States are the following:

Long Standing.—An excellent variety for spring and summer.

Prickly, or Winter.—An excellent winter variety.

Bloomsdale.—Very hardy and of good quality.

GRANVILLE LOWTHER

SPINACH DISEASES

Downy Mildew

Peronospora effusa (Grev) Rabh.

During moist weather this fungus develops a destructive disease of spinach. Pale or water-soaked spots appear, and the leaves may be rapidly killed.

SPINACH PESTS

Spinach or Beet Leaf Maggot

Pegomyia vicina Lint.

A leaf miner, distributed from the Atlantic to the Pacific, infesting beets and spinach, and sometimes rendering the latter unfit for consumption. The eggs are laid on the underside of the leaves and as soon as they hatch the larvae enter the leaf, feeding between the upper and lower surfaces. When mature the maggot drops to the soil to pupate and emerges as an olive, ash-gray fly about a quarter of an inch long.

It infests the common pigweed, or lamb's quarters, hence the most important remedy is to destroy all weeds of this variety on the premises, as well as tops of infested beets and spinach.

TWELVE-SPOTTED CUCUMBER BEETLE. See *Cucumber Pests.*

Sprays and Other Means of Control

Insecticides and Fungicides

Spraying for diseases and pests has become a very important factor in the growing of all crops and especially in horticultural work. As such it is now a regular and well established business, which has received a tremendous amount of investigation work, with the result that there is on the market a spray for every individual ailment a tree or plant is heir to. This is true of both the home-made and commercial products, and it has become an exceedingly difficult task for the orchardist or farmer to select a spray which is to give the best results for the financial outlay.

It is beyond the limits of this work to give a complete list of the formulae and uses of all these preparations, and should this be done the results would

prove unsatisfactory. It is, therefore, the aim to include only those preparations which are known to give definite and reliable results.

In general, insecticidal sprays and powders are listed in three main classes, viz.: poison sprays, contact sprays and repellents. The poison sprays are used in controlling biting and chewing insects which are capable of taking the poison internally; while the contact sprays are for piercing and sucking insects which cannot be controlled by poison sprays. The repellents do not kill, but, applied to the plants or soils. serve to drive the pests away and thus prevent attacks.

A number of the contact insecticides are also fungicides and some of the fungicides are insect repellents.

POISON INSECTICIDE FOR CHEWING INSECTS

Poisoned sprays are usually made of arsenical compounds, and are therefore known as arsenical sprays, or insecticides. Formerly Paris green and London purple were used, but of late years it has been found that lead arsenate and zinc arsenite are as efficient, cheaper and do less damage to the fruit and foliage.

These sprays are used in combatting leaf-eating insects, such as grasshoppers, army and cut worms, tent caterpillars, red-humped caterpillars, tomato and tobacco worms, cabbage worms, pear slugs, beetles, etc.

Arsenate of Lead

(1)

Arsenate of lead (poison)	1 lb.
Water	50 gals.

For newly hatched insects it is not necessary to use it stronger. For old or large insects use double the quantity. Mix the paste well with a small amount of water. Powdered arsenate of lead is about twice as strong as the paste. Do not use arsenate that settles quickly or feels gritty. Agitate while spraying.

Arsenite of zinc powdered is about four times as strong as paste lead. It may scorch in a damp season.

(2)

Arsenate of lead	4 lbs.
Water	100 gals.

It is better to purchase arsenate of lead than to attempt to make it. In mixing, preparatory to spraying, the amount of arsenate of lead for each spray tank full should be worked into a very thin paste having the appearance of milk of lime. It should never be thrown as a mass into the spray tank. This is the standard spray for codling moth and other eating insects. It is possible, however, that we shall use arsenite of zinc in the future.

O'Gara

Arsenate of Lead and Bordeaux Mixture

It is often desirable to use a combination arsenical spray with a fungicide for scab and codling moth. With Bordeaux mixture use four pounds of arsenate of lead to one hundred gallons of the preparation when ready to apply to the trees.

Lead Arsenate and Lime-Sulphur

A combination arsenical and fungicidal spray may also be made by adding five pounds of arsenate of lead to every 100 gallons of the lime-sulphur after it is properly diluted for spraying.

Essig

Bordeaux

(1)

Bluestone	6 lbs.
Good lime	6 lbs.
Water	50 gals.

Dissolve the bluestone by suspending it in a sack in 25 gallons of water in a barrel. Slake the lime in another vessel, adding a little water slowly, and dilute to 25 gallons. Mix the two thoroughly. Even the best Bordeaux may scorch in rainy weather.

O'Gara

(2)

Bluestone	6 lbs.
Good lime	4 lbs.
Water	50 gals.

Dissolve the bluestone by suspending it in a sack in 25 gallons of water in a barrel. Slake the lime in another vessel, adding a little water slowly, and dilute to 25 gallons. Mix the two thoroughly. Even the best Bordeaux may scorch in rainy weather.

For double strength Bordeaux use twice as much bluestone and lime.

This is the standard fall spray for apples and stone fruits.

W. S. C.

(3)

Bluestone (copper sulphate)	5 lbs.
Lime (unslaked)	5 lbs.
Water	50 gals.

Dissolve the bluestone by suspending it in a sack in water and dilute to 25 gallons. Slake the lime to an even paste and add water to make 25 gallons. Mix these dilute solutions by pouring together slowly into the spray tank or barrel. Strain through a 20-mesh strainer made of brass wire while pouring into

the spray tank. In large operations it is best to prepare stock solutions of both bluestone and lime. The bluestone may be dissolved at the rate of one pound per gallon of water. The lime may also be slaked, but not too far in advance of the time necessary to use it. By having a sufficient number of barrels for stock solutions, one man can easily keep three or four power spray outfits supplied with the Bordeaux mixture. An elevated platform upon which the mixing may be done will save a great deal of time. As little hand labor as possible should be the rule, and all that should be necessary in a well-appointed mixing plant should be simply opening and closing valves or gates. A scale to weigh the materials used should be a necessary part of the equipment.

Carbolated Lime

This may be used for root maggots. Work the mixture into the soil.

Lime (unslaked)	10 lbs
Carbolic acid (crude)	1 to 2 pts.
Water	50 gals

Slake the lime with a little water, add the rest of the water and the carbolic acid.

Hellebore

Hellebore	1 oz
Water	2 gals.

This is valuable as an insecticide for use on vegetables which are almost ready for market and on which arsenicals cannot be used.

O'Gara

Paris Green

If lead arsenate cannot be had, Paris green may be used as follows:

Paris green	10 ozs.
Air-slaked lime	2 lbs.
Water	100 gals

First slake the lime, stir the poison into a thin paste with a little water, add this to the lime, then strain the mixture through a sieve into a tank containing the required amount of water. If it is desired to spray for both fungi and insects on peaches or other tender foliage, 200 gallons of water should be used. *It is necessary to keep this mixture well agitated while spraying.*

As a dust Paris green is mixed as follows:

Paris green	5 ozs.
Air-slaked lime	1 lb.

The Paris green and lime are thoroughly powdered, mixed and dusted upon the plants through a muslin bag or by means of a blower.

In combination with Bordeaux mixture or lime-sulphur add eight ounces of Paris green to every one hundred gallons of the diluted spray.

Essig

Resin-Bordeaux Mixture

This is the standard spray for blackberries, raspberries and other cane fruits.

Resin	1 lb.
Sal soda crystals	½ lb
Water	½ gal.

Boil together until a clear brown color appears; then add the above to each 50 gallons of Bordeaux mixture made according to the 5-5-50 formula, given above. The reason for using the resin mixture is to cause the Bordeaux to spread and adhere better. The Resin-Bordeaux should be applied with a good spray pump and a nozzle giving a very thin fine mist spray. Keep the mixture well agitated, and before using remember that it should be carefully strained so as to keep out all material which would tend to clog the nozzle.

O'Gara

Zinc Arsenite

Zinc arsenite	2 to 6 lbs.
Water	200 gals.

A powerful poison for resistant insects, as the tussock moth, or for early spraying for canker worm and codling moth in the dry interior climates.

Essig

FUNGICIDES AND CONTACT INSECTICIDES FOR SUCKING INSECTS

Liquids

Lime-sulphur is easily the most important insecticidal spray now used and its fungicidal properties make it even more useful to the orchardist. It is especially valuable for controlling scales, insects and fungi on deciduous fruit trees, though if properly weakened it may also be used as a summer spray, particularly for the citrus and almond spiders.

Formerly lime-sulphur spray was a home-made product, but today the commercially prepared product is so superior to the home-made mixtures that the latter have almost ceased to exist.

Essig

The Iron Sulphide Spray

This is the standard spray for apple and rose mildew. The following formula is for summer use, or after the buds have opened.

Iron sulphate (copperas)	1 lb.
Lime-sulphur (32 degree Beaume test)	1 qt
Water	10 gals.

Dissolve the iron sulphate in about five gallons of water and add the quart of lime-sulphur, stirring well. Let the black precipitate settle for a few hours and pour off the liquid, keeping the precipitate. Then add five gallons of water, stir thoroughly, and let settle again. Pour

off the liquid as before. This process is called washing, and is necessary in order to get rid of the excess lime-sulphur which would burn tender foliage. Repeat the washing until the water is no longer yellow. The black "muck" should be diluted to 10 gallons and sprayed with good agitation. If plant lice are present, tobacco extract or kerosene emulsion may be mixed with it. Arsenate of lead for the codling moth may also be applied in the same mixture without any injurious effect. For making up large quantities, proportionate amounts of the materials should be used.

It is often necessary to apply the iron sulphide before the buds open, and in this case, washing is not necessary. The best way to apply it in the case of apple mildew is with the spring lime-sulphur spray. For apples badly mildewed the previous year, use the following formula:

Iron sulphate (copperas)	15 lbs.
Lime sulphur (32 degrees Beaume test)	15 qts.
Water	100 gals.

Partly fill a 100-gallon tank and add the regular amount of lime-sulphur solution for the spring spray, and to this add 15 quarts more of commercial lime-sulphur solution. Then add 15 pounds of dissolved iron sulphate and fill up to 100 gallons, stirring the mixture thoroughly; then spray with good agitation. If the lime-sulphur tests less than 32 degrees, add a little more; if over 32 degrees, a little less.

Considering the fact that for each degree Beaume there is about three-fourths of one per cent combined sulphur present, it will be easy to calculate the exact amount of any concentrated lime-sulphur solution which must be added, if the test is known.

O'Gara

Lime-Sulphur

(1)

This is the standard spray used during the spring for all fruit trees, vines, shrubs, etc., before the buds open. Lime-sulphur in concentrated form may be purchased, but there are many who prefer to boil their own solution. The proportions of lime, sulphur and water, according to the most recent investigations, are:

Lime (unslaked)	1 pound
Sulphur (flour or flowers)	2.2 pounds
Water	1 gallon

In order to make 50 gallons of lime-sulphur at one time, all that is necessary to do is to multiply the above formula by 50. The formula will read:

Lime (unslaked)	50 pounds
Sulphur (flour or flowers)	110 pounds
Water—50 to 55 gallons total product when boiled.	

Put about 10 gallons of water in the kettle or boiler and start the fire. Place the lime in the kettle, and, after slaking has well started, add the dry sulphur and mix it thoroughly, adding water enough to maintain a thin paste. Sift the sulphur so that there will be no lumps. After the slaking and mixing are completed, add water to about 50 gallons on the measuring stick or to a mark on the side of the boiler, and boil, stirring until the sulphury scum disappears. Then add water to about the height of 60 gallons and boil down to about 55 gallons if the spray is to be used at once. If it is desired to keep it for a short while, it may be boiled down to 50 gallons. During the boiling process the mixture should be well stirred. As a rule, 60 minutes of vigorous boiling will cause the sulphur to unite completely with the lime. A slow fire will necessarily take longer. Do not overboil; when the sulphur has combined with the lime and the mixture is to be applied at once, continued boiling only adds expense and does not help or benefit the spray. Properly made lime-sulphur is an amber-colored liquid, and there should be very little sediment. After settling and cooling, the mixture should be tested with a hydrometer. The following table, which may be used for the commercial as well as the home-boiled lime-sulphur, indicates the proper dilution for the various concentrations:

Table for Diluting Concentrated Lime-Sulphur Solutions

Reading on Hydrometer		Amount of dilution	
Degree Beaume	Specific Gravity	Number gals. water to one gal. lime-sulphur solution For dormant spraying	
40	1.357	1 gal. lime-sulphur	11.0 gals. water
39	1.345	1 gal. lime-sulphur	10.5 gals. water
38	1.333	1 gal. lime-sulphur	10.1 gals. water
37	1.322	1 gal. lime-sulphur	9.7 gals. water
36	1.310	1 gal. lime-sulphur	9.3 gals. water
35	1.299	1 gal. lime-sulphur	9.0 gals. water
34	1.288	1 gal. lime-sulphur	8.6 gals. water
33	1.277	1 gal. lime-sulphur	8.2 gals. water
32	1.267	1 gal. lime-sulphur	7.9 gals. water
31	1.256	1 gal. lime-sulphur	7.5 gals. water
30	1.246	1 gal. lime-sulphur	7.2 gals. water
29	1.236	1 gal. lime-sulphur	6.9 gals. water
28	1.226	1 gal. lime-sulphur	6.5 gals. water
27	1.216	1 gal. lime-sulphur	6.2 gals. water
26	1.206	1 gal. lime-sulphur	5.9 gals. water
25	1.197	1 gal. lime-sulphur	5.6 gals. water
24	1.188	1 gal. lime-sulphur	5.3 gals. water
23	1.178	1 gal. lime-sulphur	4.9 gals. water
22	1.169	1 gal. lime-sulphur	4.6 gals. water
21	1.160	1 gal. lime-sulphur	4.3 gals. water
20	1.152	1 gal. lime-sulphur	4.1 gals. water

This table is constructed for a dilution of 4.5 degrees Beaume or its equivalent 1.030 specific gravity.

Table Comparing Beaume's Hydrometer and Specific Gravities

Degrees Beaume	Specific Gravity	Degrees Beaume	Specific Gravity	Degrees Beaume	Specific Gravity
0	1.000	14	1.101	27	1.216
1	1.007	15	1.109	28	1.226
2	1.013	16	1.118	29	1.236
3	1.020	17	1.126	30	1.246
4	1.027	18	1.134	31	1.256
5	1.034	19	1.143	32	1.267
6	1.041	20	1.152	33	1.277
7	1.048	21	1.160	34	1.288
8	1.056	22	1.169	35	1.299
9	1.063	23	1.178	36	1.310
10	1.070	24	1.188	37	1.322
11	1.078	25	1.197	38	1.333
12	1.086	26	1.206	39	1.345
13	1.094			40	1.357

Rules for Determining Number of Dilutions and Density of Spray

If the density of the commercial solution or the home-made wash has been first determined by the use of a hydrometer, sprays of any desired density may be calculated by using the above table. Hydrometers do not detect impurities in lime-sulphur solutions; these can be determined only by chemical analysis. The rule for obtaining the number of dilutions is as follows: Divide the decimal of the concentrate by the decimal of the spray desired, the quotient will be the number of dilutions. Example: The concentrated lime-sulphur solution tests 34 degrees Beaume, which by the table is 1.288 specific gravity. It is desired to use the lime-sulphur solution to spray upon trees at 3 degrees Beaume, which is 1.020 specific gravity. The decimal of the concentrate is .288, which, divided by .020, equals 14.4, which is the number of dilutions required, and which, of course, is obtained by adding 13.4 volumes of water to one volume of the concentrated lime-sulphur solution. This rule is based upon the general fact that the density of a solution heavier than water varies inversely with the

number of dilutions. Another example: Supposing the decimal of the concentrate is known and this concentrate is diluted by a certain number of volumes of water, what is the decimal of the spray? Let us take the figures in the example above. The decimal of the concentrate is .288 and 13.4 volumes of water are added to it. 13.4 plus 1 equals the number of dilutions. .288 divided by 14.4 equals .020, which is the decimal of the spray and corresponds to 3 degrees Beaume.

Self-Boiled Lime-Sulphur

This is the standard summer spray for peaches and other stone fruits to prevent the fruit spot disease. Its use, however, is never necessary if proper fall spraying with Bordeaux has been done. This spray is much safer than dilute lime-sulphur solutions, as it will not injure foliage. It may be used to prevent apple and pear scab where this disease appears. It also has a beneficial effect in a limited way in the control of scale. Infestation of the fruit may be checked by its use.

Lime (unslaked)	8 pounds
Sulphur (flour or flowers)	8 pounds
Water	50 gallons

The lime should be placed in a barrel and enough water poured on to almost cover it. As soon as the lime begins to slake, the sulphur should be added after sifting it so as to break the lumps. The mixture should be stirred and more water added as needed to form a thick paste at first, and then gradually a thin paste. The heat of the slaking lime will cook the mixture, and from five to 15 minutes will be necessary, according to the quickness of the lime. Be sure not to let it overcook, as this would tend to form compounds which would burn. As soon as the sulphur and lime have reached the paste state, fill up the barrel to 50 gallons with cold water. Do not use any hot water in making this mixture. For large operations, proportionate amounts of lime and sulphur should be used, and it will be found that it is easier to make large quantities than small amounts.

Lime-Sulphur
(2)

Fresh stone lime	½ pound
Sulphur	1 pound
Water	½ gallon

Slake the lime in the cooker. Add the sulphur and the water. Boil briskly till the sulphur is dissolved (about 45 minutes), stirring continuously and keeping the cooker covered. As it boils down keep adding water. When finished let settle. Use only the clear liquid, which may be stored if kept from the air. Prepared in this way lime-sulphur should have a hydrometer reading of about 26 degrees, but little weaker than the factory-made product. Write for bulletin on lime-sulphur—Popular Bulletin No. 28.

For use, any concentrated lime-sulphur may be diluted according to the following table:

Hydrometer test of concentrate		To make dilute spray	
Beaume Degrees	Specific Gravity	Beaume, 3° sp. gr. 1.02 lb. sulphur in 5 gals. Winter spray	Beaume, 1.5° sp. gr. 1.01 1 lb. sulphur in 10 gals. Summer spray
34	1.302	3 to 14 water	1 to 28
32	1.279	13	26
30	1.259	12	24
28	1.236	11	22
26	1.215	10	20
24	1.196	9	18
20	1.158	7	14
16	1.122	6	11

W. S. C. formula lime sulphur.

Lime-Sulphur and Flour Paste

For spraying trees in foliage and tender plants a lime-sulphur flour paste spray has given remarkably good results. The following formulæ are recommended:

No. 1.

Water	200 gals.
Flour paste, 8 lbs. flour in	8 gals. water
Sublimed sulphur	10 lbs.
Lime-sulphur solution	2½ gals.

The flour is first made into a thin paste by adding one pound to each gallon of water, according to the above formula. The sulphur is made into a paste also and added with the flour paste and lime-sulphur solution to the two hundred gallons of water in the spray tank. This spray is excellent for the red spider on almond and citrus trees. Minus the lime-sulphur solution it is a very effective spray for the yellow mite (*Tetranychus bimaculatus*) on hops.

No. 2. (Iron sulphide.)

Water	200 gals.
Flour paste, 8 lbs. flour in	8 gals water.
Lime-sulphur solution	2½ gals.
Iron sulphate	4 lbs.

This spray is mixed as the preceding, and the iron sulphate after being dissolved is added directly to the diluted mixture in the tank.

The above spray is especially recommended for late summer sprayings for red spider, but should not be applied to fruit trees just before the fruit is ready to pick, as the fruit might be stained.

ESSIG

Pyrethrum

Pyrethrum	1 oz.
Water	2 gals.

This is a contact insecticide but is not poisonous to man. Burning a little pyrethrum powder in a room will tend to destroy flies and mosquitoes. It may be dusted on plants as a dry powder.

Tobacco Decoctions

For soft-bodied insects in greenhouses, conservatories, or on house plants, as well as for plant lice, leaf hoppers and other similar insects in the open, the tobacco decoctions are invaluable because they do not injure the foliage, and give excellent killing results.

(1)

Tobacco black leaf	1 gal
Water	65 gals

(2)

Sulphate of nicotine (black leaf 40)	1 pt.
Water	112 to 125 gals.

This is the standard summer spray for sucking insects, such as green aphis, woolly aphis and other aphides.

Commercial Extracts

(3)

The extract containing two and three-fourths per cent nicotine should be diluted to sixty parts of water. The extract containing 40 per cent nicotine should be diluted from one to one thousand parts or one to fifteen hundred parts of water.

Home-made Extract

(4)

Tobacco leaves or stems	1 lb.
Water	4 gals.

Steep the tobacco in the hot water and apply directly.

(5)

Blackleaf 40	12½ lbs.
Fish-oil soap	35 lbs.
Water	1,000 gals

Dissolve the soap in hot water. Blackleaf (old style) is one-tenth as strong.

For orchard mites or scab add 36 gallons of 32-degree lime-sulphur.

EMULSIONS

Emulsions are oil sprays in which soap is used as an emulsifying agent. They are especially valuable where high power of penetration is necessary or where there is a waxy covering to overcome, as in the case of woolly aphis, mealy bugs, etc. They also have the power of rapid and even distribution over the sprayed surface. If properly prepared, emulsions and water mix easily without agitation and are suitable for spraying tough and tender foliage alike.

Certain commercial emulsions are made by breaking up the oils into exceedingly small particles, thus forming a creamy liquid which readily mixes with water.

Carbolic Acid Emulsion

(1)

This, like the above formula, may be used to destroy eggs and young maggots infesting onions, radishes and other garden crops.

Carbolic acid (crude)	1 pt.
Soap (hard)	1 lb.
Water	1 gal.

Dissolve soap in boiling water; add acid and stir or churn, as in making kerosene emulsion, until the substance becomes creamy. To use, dilute one part of the emulsion by adding 30 parts of water.

(2)

Whale-oil soap	40 lbs.
Crude carbolic acid	5 gals.
Water to mix	40 gals

Dissolve the soap in hot water (the soap must be entirely dissolved); add the carbolic acid and heat to the boiling point for twenty minutes (reserve some water to add in case the mixture begins to boil over). For use add twenty gallons of water to every gallon of the above stock solution. The emulsion needs little or no agitation.

This spray is especially recommended for mealy bugs, but is also suitable for plant lice and soft brown scales. It is also a good contact insecticide for ants.

Crude Oil Emulsion

Water	175 gals.
Liquid soap	3 gals.
Crude oil	25 gals.

Fill the spray tank with the 175 gallons of water; add the liquid soap; agitate thoroughly for one minute, after which add the crude oil, continuing the agitation.

If the liquid soap cannot be had, use 20 pounds whale-oil soap, dissolved in 10 gallons of boiling water, to which three pounds of lye have been added.

During the spraying operation this mixture should be thoroughly agitated and great care taken to wet all of the twigs. From 8 to 15 gallons should be used on a tree. The application should be made from November to February.

The crude oil emulsion is especially recommended for black scale (*Saissetia oleae*), European fruit scale (*Lecanium corni*), European pear scale (*Epidiaspis piricola*), cherry scale (*Eulecanium cerasorum*) and other scales infesting deciduous fruit trees. It should be applied in the winter, when the trees are dormant.

To also kill moss or lichens on fruit trees add two pounds of lye to the formula of the stock solution.

Essig

Distillate Oil Emulsion

This is the standard spray for thrips.

Water	6 gals.
Lye (98 per cent)	2 lbs.
Fish oil	1½ gals.

Put water in boiler and add lye. When dissolved and the water boiling, pour in fish oil, and boil for two hours. When soap has boiled sufficiently it should have a ropy effect when stirred. This formula gives about 40 pounds of moderately firm soap.

The distillate-oil stock emulsion should be made as follows:

Hot water	12 gals
Fish-oil or whale-oil soap (above formula)	30 lbs
Distillate oil (raw) 30 to 34 degrees Beaume	20 gals

Have the water boiling when put into the spray tank and add soap while agitator is running at good speed. When soap is thoroughly dissolved, pour in the distillate oil slowly, keeping the mixture well agitated. When oil and soap are well mixed, pump out through the spray nozzle at a pressure of not less than 175 pounds into a storage tank. This is the stock emulsion, and contains 55 per cent oil. To make a three per cent emulsion use five and one-half gallons of this stock in each 100 gallon tank. To dillute first put the stock emulsion in spray tank and then add water, keeping agitator running. To make the spray more effective, tobacco black leaf or sulphate of nicotine may be added after the emulsion has been diluted. The amount of each to add will be in accordance with formulae given elsewhere.

O'Gara

Distillate Oil Mechanical Mixture

Water	200 gals.
Caustic soda (95 per cent)	7 lbs.
Distillate (28 degrees Beaume)	10 gals.

Fill spray tank with the required amount of water; add the caustic soda, which has been dissolved in a small amount of water and then the distillate. Keep agitator going rapidly while applying the spray.

This spray has been thoroughly tested by the writer and is one of the cheapest and best for spraying black scale (*Saissetia oleae*) or the European fruit scale (*Lecanium corni*) on apricot and olive trees.

Distillate Emulsion and Tobacco

Government formula for pear thrips:

Water	12 gals.
Whale-oil soap	30 lbs.
Distillate (32 to 34 degrees Beaume)	20 lbs.

The above emulsion is prepared in the ordinary way as a stock solution. For use in the orchard dilute one to twenty parts of water. To every two hundred gallons of this diluted spray add one pint of tobacco extract containing forty per cent nicotine or about three and one-half gallons of tobacco extract containing two and three-fourths per cent nicotine.

This spray is especially recommended for pear thrips.

Essig

Kerosene Emulsion

(1)

Kerosene	2 gals
Hard soap (whale-oil soap)	½ lb
Water	1 gal

Dissolve soap in water by boiling; add hot suds to the kerosene. Do not do this

near a fire. Agitate the mixture with a spray pump so as to emulsify the oil. After five minutes the mixture becomes creamy. To use, dilute the above stock solution at the rate of one gallon to 10 gallons of water. This is a standard remedy for destroying green aphis, woolly aphis, mealy bugs and other plant lice. It may be used instead of the tobacco solutions if desired.

O'Gara

(2)

Whale-oil soap	40 lbs.
Water	2 gals.
Kerosene	4 gals.

First dissolve the pound of soap in two gallons of hot soft water. When this is accomplished add the kerosene and agitate vigorously by pumping it back into itself until a thick creamy liquid results. This makes the stock solution.

For use on dormant trees and plants in the winter dilute the stock solution one to five of water. On trees or plants in foliage dilute with ten parts of water.

In giving directions for diluting kerosene emulsion many writers recommend the use of a certain per cent. This is exceedingly confusing to the average orchardist, and in order to have the information necessary to follow these recommendations the following dilutions showing per cent of strength are taken from O'Kane:

For 4% strength add 15 2/3 gallons of water to 1 gallon of stock solution
For 5% strength add 12 1/3 gallons of water to 1 gallon of stock solution
For 7% strength add 8 1/2 gallons of water to 1 gallon of stock solution
For 10% strength add 5 2/3 gallons of water to 1 gallon of stock solution
For 12% strength add 4 1/2 gallons of water to 1 gallon of stock solution
For 15% strength add 3 1/2 gallons of water to 1 gallon of stock solution
For 18% strength add 2 2/3 gallons of water to 1 gallon of stock solution
For 20% strength add 2 1/3 gallons of water to 1 gallon of stock solution
For 25% strength add 1 2/3 gallons of water to 1 gallon of stock solution

Essig

Oil Spray

Crude oil emulsion for winter spraying:

Fish-oil soap .... 20 lbs.
(Dissolved in 20 gals. hot water)
Lye .... 4 lbs.
(Dissolved in 2 gals. water)
Mix, add water to make 177 gals., run agitator at full speed and add
Crude oil .... 20 gals.

When emulsified do not add anything else to the spray liquid, or free oil will separate.

W. S. C.

Resin Wash

Though not a true emulsion and fast losing prominence as a spray, this wash is included here because of its value as a spray and dip for plants with tender foliage.

Resin	10 lbs.
Caustic soda (76 per cent)	3 lbs.
Fish oil	1½ lbs.
Water	50 gals

Put oil, resin and a gallon of water in an iron kettle and heat until the resin is softened; add the lye (dissolved in a small amount of water) and stir thoroughly, after which add enough water to make fifty gallons of spraying material.

This wash is only effective for young scale insects, plant lice, or other soft-bodied insects.

Soap Solution

1½ inch cube soap.
1 gallon warm water.

Soap Washes

A simple and easily prepared spray for use in small gardens is made from soap as follows:

Whale-oil or hard laundry soap	1 lb.
Water	5 gals.

The soap is first dissolved in a small amount of hot water and the remainder added afterwards. This spray will not injure tender plants or foliage, and is recommended only for young scale insects, plant lice and other soft-bodied insects.

E. O. E.

Whale-Oil Soap and Quassia

Whale-oil soap	10 lbs.
Quassia	5 lbs.
Water	100 gals.

Place the quassia chips in a sack, cover with about 10 gallons of water and soak for 24 hours. Then boil, remove the chips, add the soap and boil until dissolved. Add water to make 100 gallons. For making whale-oil soap see formula given elsewhere. This formula has given good success in destroying soft-bodied insects like plant lice, young squash bugs, etc.

P. J. O.

DUSTS

A number of valuable insecticides are applied dry as dusts. We have already referred to Paris green and lime as being

used in this way. Dusts are easy to mix and handle and are often of great service to the farmer and orchardist.

Flowers of Sulphur

For a number of years flowers of sulphur was used alone as a remedy for mites on citrus and almond trees. It was distributed over the trees by hand or with a blower in the early morning when the foliage was damp, thus enabling it to adhere. The warm sunshine oxidizes the sulphur, the liberated sulphur-dioxide being the killing factor. Accordingly sulphur is of little avail in the cool summer weather of the coast counties or during the winter months anywhere. However, in the warm interior districts this is still a very effective remedy for mites.

Lime and Sulphur

Even better than sulphur alone is dehydrated lime and flowers of sulphur mixed in equal parts and blown upon the trees with a power machine. In citrus orchards this is a very important method of controlling the citrus red spider (*Tetranychus mytilaspidis*) and the six-spotted or yellow mite (*Tetranychus bimaculatus*).

Lime-Sulphur and Sal Bordeaux

This mixture is prepared as follows:

Dehydrated lime (finely powdered slaked lime)	40 lbs.
Flowers of sulphur	5 lbs.
Sal Bordeaux (a mixture of bluestone, charcoal and naphthol)	5 lbs.

Mix these ingredients thoroughly and apply with a power blower. This is one of the most efficient preparations now being used in controlling the almond red spider (*Bryodia pratensis*).

Essig

Hellebore

Powdered white hellebore has been used for many years as a specific remedy against "currant worms," "rose slugs" and other saw-fly larvae, and is very effective, either dusted on as a powder, or in the form of a decoction. In the field it is now quite generally replaced by arsenate of lead or even Paris green, but in the garden it still holds its own. When applied, it may be used pure, or it may be mixed with two or three times its own weight of dust, cheap flour, lime, or almost any other light, finely powdered material. When used as a spray, steep one ounce in one quart of boiling water and add another quart of cold water when ready to apply.

It is also quite effective against certain root maggots, like those affecting cabbage and cauliflower. For these it is used in the form of a decoction, one ounce in one gallon of water and about half a pint poured around an infested plant, from which the earth has been drawn away to facilitate soaking directly around the plants. To be effective, the material must be brought into direct contact with the insects. Hence, it should be liberally used and applied before the maggots get down too far, or into the plant too deeply. In the garden its use is quite practical; in the field it has not been found so satisfactory.

Pyrethrum

This is commonly known as Persian or Dalmatian insect powder, or Buhach, and comes as a finely ground yellow powder with a pleasant, rather pungent odor. It is a contact poison, and most larvae and soft-bodied insects are thrown into convulsions when they come under its influence. Unfortunately it is not only expensive but quickly loses its effectiveness when exposed to the air. Its practical range is therefore limited, and it is chiefly used on house plants, in the conservatory and in the garden. It is entirely harmless to vegetation of all kinds, and does not spot or mark even the most delicate flowers when used dry. It acts a little more promptly and effectively if applied to the insects while they are moist, or at least damp. If the dusty appearance is objectionable, a decoction may be made by steeping one ounce in one quart of boiling water, and then adding two or three quarts of cold water. Into this material potted plants may be dipped, or it may be applied with an atomizer. Against plant lice on house plants this makes a very clean and effective application.

REPELLENTS

It is apparent that certain materials, applied to the foliage of plants, are some-

what repulsive to some insects. One of the most important of these repellents is the well known fungicide, Bordeaux mixture. Because of this and its use as a combined insecticide and fungicide the formula and directions for making are here presented quite fully.

Bordeaux Mixture

Unslaked lime	4 lbs.
Copper sulphate (bluestone)	4 lbs.
Water	50 gals.

The task of mixing these chemicals, where large quantities of the spray is used, is no small thing in itself. A great deal of study has been given to the construction of suitable mixing apparatus.

The first consideration is to get the materials high enough on a platform so that they can be easily and rapidly placed in the spraying tanks of the power machines. This is done by constructing at convenient places in the orchard platforms large enough to hold a large box for slaking lime, a lime solution agitator, and a vat for dissolving the bluestone. Such a platform is about 12 feet square and 4½ feet high. A large standpipe for filling the tanks is desirable, or the water must be pumped into the tank while the solutions are being added.

The lime is first slaked in a common vat for that purpose. The great trouble has always been to keep the slaked lime agitated properly when it was being drawn off to mix with the bluestone in the spraying tank. This problem has been solved by the use of a special agitator for this purpose. The lime from the slaking vat is strained into this tank through the slanting bottomed strainer. The agitator works by means of a hand lever and the contents of the tank may be thoroughly mixed in a few minutes before it is drawn off for use. Here it is again strained through the strainer as well as is the bluestone.

The bluestone vat contains slats, across the entire box or simply across one end. These slats must be low enough so that the bluestone, which is placed upon them in sacks, will be completely immersed in the water. This method admits quick dissolving of the bluestone, much more rapidly than if simply poured into the tank and stirred.

The lime and bluestone are mixed with a given amount of water so that the proper quantities of the resultant solutions can be measured so as to give the mixture the strength of the above formula.

The sieve used should be made of brass wire and contain 20 meshes to the inch.

This spray is usually used as a repellent for the flea beetles, cucumber beetles, diabrotica, and other leaf-eating insects.

POISON BAITS

Poison baits occupy a very important place in the control of certain insects, such as grasshoppers, army and cutworms, wireworms, etc., and are especially useful to the small gardener though they have often been used with excellent results in large fields and orchards.

Poison Bran Mash

No. 1

Bran	25	lbs.
Paris green	½	lb.
Cheap molasses	1	qt.

No. 2

Bran	40	lbs.
Arsenic	5	lbs.
Molasses	2	gals.

In preparing these mix the arsenic or Paris green and bran dry, and add the molasses, which has been diluted in water. Add enough more water to moisten the bran so that it will appear between the fingers when the mixture is squeezed in the hand.

Some prefer to moisten the bran first and afterwards stir in the molasses and poison.

Ant Poison

Syrup containing between one-quarter and one-eighth of one per cent arsenic. A sponge saturated with the arsenic solution and placed in a small fruit jar with perforated cover should be placed where the ants frequent. Carbon bisulphide may be applied to the nests in the ground.

Bran-Arsenic Mash

White arsenic	1 lb.
Brown sugar (or molasses)	1 to 2 lbs.
Bran	6 lbs

Thoroughly mix the above and add enough water to make thoroughly wet. A spoonful should be placed near the crown of each tree. The mash may be used to kill grasshoppers, but it is usually best to cover the trees and use the Bordeaux mixture as a repellent.

Bran-Paris Green Mash

Paris green	1	lb.
Bran	40	lbs.
Molasses or sugar	1 to 2	lbs.
Salt	½	lb.

Make a mash by adding water; add molasses (or sugar) and salt; mix thoroughly and scatter in small piles among plants or in beds before planting. This bait will prove more or less effective in killing cutworms and cabbage worms. It may be sown among the rows of plants to be protected. It is valuable for destroying cutworms in young onions.

Criddle Mixture

Though this mixture is somewhat disagreeable to make and handle, it is exceedingly cheap and effective, especially for grasshoppers.

Fresh horse dung	60 lbs.
Common salt	2 lbs.
Paris green	1 lb.

The Paris green is mixed with enough water to form a paste and is then stirred thoroughly into the horse dung with the salt.

These poisoned baits are scattered about in fields infested with grasshoppers, army and cutworms and various other destructive chewing insects, or they may be placed in advance of the oncoming hordes. A very important thing in handling the poisoned baits is to see that they are kept moistened all the time, as they become worthless when dry. To prevent this drying out the mixture should be put out in small piles and occasionally moistened. They may also be placed under boards or in the shade, while for cutworms and wireworms it is often advisable to bury them in the ground.

*FUMIGATION

Fumigation consists in the generation and uses of gases to kill destructive insect pests. Formerly such practices were limited to the uses of carbon bisulfid, sulphur dioxid and tobacco fumes. The use of hydrocyanic acid gas in citrus orchards has lately been so perfected as to become of very great importance, and has opened up a remarkable field in the control of orchard pests.

Carbon Bisulfid

Carbon bisulfid is a liquid which evaporates into a heavy, highly explosive gas. It was first used for fumigating beans, grains or cereals for weevils, and is still a very efficient method of controlling such pests. In handling the liquid great care should be taken to keep it away from a flame on account of its being highly explosive.

For Storehouse Pests

Before fumigation is begun care should be taken to see that the room or container is made as tight as possible. The temperature should be 70 degrees Fahrenheit, or above, as poor and unsatisfactory results are sure to follow even excessive doses at a lower temperature. In a tight compartment five pounds to every 1,000 cubic feet gives excellent results in killing weevils. If the compartments cannot be made tight, increase the amount of carbon bisulfid.

For Root Pests

In the field this liquid is used to kill root pests, as woolly aphis, black peach aphis, phylloxera, grubs, maggots, etc., but is practical only in sandy or porous soils. For a small plant a single hole is made near the base and a teaspoonful of the liquid poured in and the hole covered to prevent outside evaporation. For larger plants several or many holes should be made, deep enough to allow the liquid to evaporate around the infested roots. A syringe-like instrument is sometimes used to inject the liquid around the roots.

For Borers

Injections of carbon bisulfid into the burrows of wood borers and stopping the entrance of the burrows will kill all the insects reached by the gas.

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* For further information relative to fumigation, see

Bulletin No. 76, Bureau Entomology, U. S. Department Agriculture, by A. W. Morrill.

Bulletin No. 79, Bureau of Entomology, U. S. Department Agriculture, by R. S. Woglum.

Bulletin No. 90, (Part I.) Bureau of Entomology, U. S. Department of Agriculture, by R. S. Woglum.

Bulletin No. 90, (Part II.) Bureau of Entomology, U. S. Department of Agriculture, by R. S. Woglum.

Bulletin No. 152, California Agriculture Experiment Station, by C. W. Woodworth.

Circular No. 11, California Agriculture Experiment Station, by C. W. Woodworth.

Circular No. 50, California Agriculture Experiment Station, by C. W. Woodworth.

For Ants and Wasp Nests

A small amount of this liquid poured into underground nests of ants, wasps, etc., will suffice to destroy the inhabitants very quickly.

Hydrocyanic Acid Gas

Hydrocyanic acid gas is generated by the addition of diluted sulphuric acid to sodium or potassium cyanide. The generation is made in an earthenware jar, the gas being confined in a fumigation house or, if the work is being done in the orchard, in a tent thrown over the tree. For many years the methods of fumigation depended entirely upon each fumigator, there being no uniform or common procedure. The results of this early work so clearly showed the need of systematism that the United States Department of Agriculture set experts to work out a reliable and uniform system of procedure. Dr. A. W. Morrill inaugurated the present system of marked tents and a system of dosage, which is known as "The Morrill System." This work was done in Florida. Later Mr. R. S. Woglum began operations in California and greatly perfected this system, so as to make it at once practical and available to all the orchardists.

HYDROCYANIC ACID GAS

Potassium cyanide	1 oz.
Sulphuric acid	1 fluid oz.
Water	3 fluid ozs.

Place water and acid in earthenware vessel and add cyanide. To be used under tents or tight rooms or boxes.

For fumigating buildings or nursery stock, one ounce of cyanide to each 100 cubic feet for one hour.

For scale insects on citrus trees, maximum or purple scale dosage found by multiplying distance around by distance over top of tented tree and pointing off two places. Example:

Distance around Distance over
40 ft. / 20 ft.—8 ozs. cyanide

For red or black scale, reduce one-quarter. Example:

Distance around Distance over
40 ft. / 20 ft.=8. -¼=6 ozs. cyanide

FUMIGATION SCHEDULE. See page 1499.

Tobacco Fumes

For very tender house and greenhouse plants infested with plant lice, thrips, etc., it is sometimes advisable to fumigate them with slowly burning tobacco, but even in such cases hydrocyanic acid gas is replacing the more uncertain tobacco fumes.

BANDS

To prevent insects from crawling up the trunks of trees and plants various bands have been devised which have proven exceedingly successful in many instances.

Asphaltum

A strip 6 to 8 inches wide painted about base of tree trunk to prevent the entrance of the peach-tree borer.

Cotton Bands

Bands of loose cotton fastened around the trunks of the trees are excellent in preventing the ascent of insects.

Mosquito wire netting similarly applied is also in use against the canker worm.

Oiled Paper

Oiled paper tied around the trunks of small vines and plants is an old method which sometimes proves practical today.

Sticky Rope

In the work on the California tussock moth, W. H. Volck recommends the use of rope bands saturated in an easily prepared mixture as follows:

Castor oil	1 gal.
Resin	16 lbs.
(or any fraction thereof)	

The resin and castor oil are gently heated until the former is completely melted. If too thick more oil may be added. The bands dipped in this mixture should be replaced by new ones about every ten days.

Crude oil rich in asphaltum or a mixture of equal parts of pine tar and molasses have also given satisfactory results.

Tanglefoot

Tree tanglefoot is a thick, sticky substance which, when applied as a band, remains moist for several weeks and is a very effective barrier against canker worms, caterpillars, cutworms, Fuller's rose beetle and other crawling insects.

The material is put up in cans. It should be applied directly to the trunk of the tree several feet above the ground.

MISCELLANEOUS FORMULAE

Corrosive Sublimate

Bichloride of Mercury

This is the standard disinfectant when working pear blight. No other disinfectant should be used to wash the cut surfaces or to disinfect the pruning tools.

Corrosive sublimate	1 part
Water	1,000 parts

Corrosive sublimate may be purchased in tablet form at drug stores, and directions for making solutions will be found on the container. Never put corrosive sublimate into a metallic container, always use a glass bottle. Be sure to label the bottle "POISON" in large, plain letters. It is the deadliest of poisons.

Formalin

Formaldehyde

Formalin (40 per cent solution)	1 pt.
Water	30 gals.

This is a preventive of potato scab and smut of grains. Potatoes and grains should be soaked in it for about two hours. Smut of onions may also be prevented by treating the seed. Practically all garden seeds will be disinfected by the use of this formula.

Pine Tar

For soil-infesting, seed-eating insects such as the wireworm, tar may be used with good results.

Pine tar	1 teaspoonful
Seeds	15 lbs.

Dampen the seeds, such as corn, squash, cantaloupes, etc., with a little warm water. Put in the tar and mix thoroughly; allow to dry before planting. The tar acts as a repellent.

WHITEWASHES

(1)

Government Whitewash

Lime (unslaked)	40	lbs.
Salt	15	lbs.
Rice flour (or ground rice)	3	lbs.
Spanish whiting	½	lb.
Glue	1	lb.
Water	5	gals.

Slake the lime in warm water and cover so as to keep in the steam; strain through a fine sieve or strainer; add the salt, well dissolved, in warm water. Then add the rice boiled hot; the Spanish whiting; and finally the glue which has been previously dissolved over a slow fire. Lastly, add the five gallons of hot water. Stir well and let stand for a few days. Apply hot with a brush. One pint of the mixture will cover a square yard. Coloring matter may be put in, such as Spanish brown, yellow ochre, etc.

(2)

Whitewash for Trees

Lime (air slaked)	30 lbs.
Tallow	4 lbs.
Salt	5 lbs.
Water	Enough to make wash flow well

When old trees are cut back for topworking, they may be protected from sun scald by using the above wash.

(3)

Whitewashing the limbs of trees has been an old practice of considerable merit, because it serves somewhat as an insecticide and a fungicide. It also prevents sunburn.

Lately whitewash has been used with considerable success in the control of pear thrips, as follows:

Quick lime	80 lbs.
Water	100 lbs.

After the lime is slaked and mixed the material should be strained through a fine sieve into the spray tank.

WHITE LEAD PAINT

White lead, slightly thinned with linseed oil, should be used where large cuts are made, or in cases where the wood is exposed by the removal of the bark and cambium, as in the case of pear blight eradication. It should not be applied in the latter case until it is certain that the disease has been eradicated.

GRAFTING WAX

(1)

Resin	4 lbs.
Beeswax	2 lbs.
Tallow	1 lb.

(2)

Resin	3 lbs.
Beeswax	2 lbs.
Tallow	2 lbs.

(3)

Resin	4 lbs.
Beeswax	2 lbs.
Linseed oil	1 pt.

Grafting Wax for Walnuts

(1)

Beeswax	1 lb.
Resin	5 lbs.
Linseed oil	1 pt.
Lamp black	1 oz.

(2)

Beeswax	1 lb.
Resin	5 lbs.
Linseed oil	1 pt.
Flour	1 pt.

APPROXIMATE COST OF SPRAYING MATERIALS

The following prices have been secured from a large number of dealers, and represent the average retail cost of these materials. Such prices, though exceedingly variable, enable the grower to arrive at the approximate cost of a spray and also show that it is desirable to buy in as large quantities as possible.

Arsenate of Lead

Paste, 15 per cent	Per lb.
In 5 lb. steel containers	$0.13½
In 10 lb. steel containers	.12¾
In 25 lb. steel containers	.12
In 50 lb. steel containers	.10½
In 100 lb. steel containers	.10

Arsenate of Lead

Dry	Per lb.
In 1 lb. lots	$0.32
In 5 or 10 lb lots	.30
In 50 lb. lots	.26

In ton lots these prices are reduced 10 per cent

Arsenite of Zinc

Powder	Per lb.
½ or 2 lb. cartons	$0.20
48 lb. cartons	.18

Caustic Soda

Powdered, 98 per cent	Per lb.
In 5 lb. lots	$0.05½
In 25 lb. lots	.05
In 100 lb. lots	.04½
In 500 lb. lots	.04
In ton lots	.03½

Commercial Lime-Sulphur Solution

	Per Bbl.
In lots of from 1 to 25 barrels	$10.00
In lots of 20 barrels	9.00
In lots of 100 barrels	8.00

There is an extra charge of from $1.00 to $1.50 on each barrel which if returned is refunded.

These prices are f. o. b. at point of destination.

Copper Sulphate

The price of this commodity is exceeding variable, but at present is as follows:

Bluestone	Per Lb.
In 5 or 25 lbs lots	$0.25
In 100 lb lots	09
In 150 lb. lots	.07½
In 2,000 lb lots	.07
In car load lots	.06

Crude Carbolic Acid

15 to 20 per cent phenol	Per Lb.
In 1 lb lots	$0.25
In 5 lb lots	.23
In 25 lb. lots	.22
In 50 lb lots	.20

Crude oil may be purchased at from 3 to 5 cents a gallon.

Distillate

28 degrees Beaume	Per Gal.
In 1 gal. lots	$0.10
In 5 gal. lots	.08
In 25 gal. lots	.07
In 50 gal. lots	.06

Containers extra.

Kerosene

Cheap grade	Per Gal.
In 1 to 5 gal. lots	$0.15
In 25 gal. lots	.13½
In 50 gal. lots	.12

Lime

Unslaked	
In 5 to 25 lb. lots	2 cents per lb.
In 100 lb. lots	$1.15 per 100 lbs.
In barrels of 220 lbs.	$1.50 to 1.85 each

Paris Green

	Per Lb.
1 lb. lots	$0.30
5 or 10 lb. lots	.27
50 or 100 lb. lots	.25

Pyrethrum

Powdered	Per Lb.
In 1 lb. lots	$0.36
In 5 lb. lots	.34
In 10 lb. lots	.32
In 50 lb. lots	.30

Resin

	Per Lb.
In 5 lb. lots	$0.05
In 25 lb. lots	.04½
In 100 lb. lots	04
In 500 lb. lots	$3.85 per 100 lbs.
In ton lots	3.75 per 100 lbs.

Sulphur

Flowers or resublimed	Per Lb.
In 5 lb. lots	$0.04
In 25 lb. lots	.03½
In 100 lb. lots	.02¾
In 500 lb. lots	$2.65 per 100 lbs.
In ton lots	2.50 per 100 lbs.

Tobacco Extract

40 per cent	
1 gal. cans	$1.15 per gal.
5 gal. cans	.90 per gal.
10½ gal. cans	12.00

Whale-Oil Soap

	Per Lb.
In 5 lb. lots	$0.10
In 25 lb. lots	.07¾
In 40 to 45 lb. lots	.04

PESTS CONTROLLED BY OTHER REMEDIES THAN SPRAYING

Pear Blight (Fire Blight of Pear and Apple)

Prune out every sign of blight, cutting well below the disease. Swab the cut and tools after every cut with corrosive sublimate (1 to 1,000 of water).

Western Tomato Blight

Set out strong plants close together, or plant the seed thickly in the rows. Give best of care, shade and plenty of water. You will probably lessen the blight.

Potato Scab

Soak seed for two hours in formalin (one pound to 30 gallons of water), then cut and plant. Do not plant in soil where scabby potatoes were grown.

Root Maggot of Radish, Turnip, Cabbage, Etc.

Spray soil with carbolated lime before maggots appear. Repeat often. Cultivate well after crop is removed. Place a three-inch tarred paper collar on young cabbage plants.

Cabbage Worms

Paris green one part, bran 40 parts. Mix well. Dust the plants before worms eat in.

Climbing Cutworms
Garden Cutworms

Paris green one part, bran 40 parts. Make a mash by adding water. Season with a little molasses, stale beer or salt. Scatter by spoonfuls before planting or among plants.

Woolly Aphis on Roots

Expose the roots as much as practicable and spray with tobacco, kerosene emulsion or sulphur-lime. Root treatment is not completely reliable.

W. S. C.

FUMIGATION FOR NURSERY

For nursery stock, use one ounce cyanide to 100 cubic feet.

For grafts and scions, use two-thirds ounce cyanide to 100 cubic feet.

To every ounce of pure potassium cyanide (poison) add one and one-half liquid ounces sulphuric acid diluted with two and one-half ounces water. The gas generated is extremely poisonous. Fumigate 30 to 45 minutes.

SPRAYING CALENDAR

P. J. O'Gara

The following information was issued from the office of the pathologist for the Rogue River valley, Oregon, and will be adequate for all similar situations:

Attention is called to the part devoted to the use of lime-sulphur in the spring. It will be seen that black-leaf 40 is combined with lime-sulphur where aphides must be combatted. This combination makes a rather costly spray, but if properly applied will save spraying later on for aphides. The rosy aphis is a serious pest because it attacks the fruit clusters.

Fig. 1. At this stage of development, just before the blossom clusters open, the orchard should be sprayed for scab, with dilute lime-sulphur or Bordeaux. Arsenate of lead is added for control of insects.
(Purdue Experiment Station)

The nitrate of soda spray for stimulating shy bearing trees has also been included. As indicated, the nitrate of soda may be mixed with the lime-sulphur, especially in the spraying of pears, or in spraying apples where it is not necessary to delay lime-sulphur spraying until the buds begin to swell.

The iron-sulphide spray has been omitted and in its place atomic sulphur is advised. The iron sulphide spray is very effective, but the trouble of making it up has sometimes deterred fruit growers from doing the necessary spraying in the prevention of apple mildew.

Fig. 2. Showing Blossom Cluster Just After Petals Have Fallen. This is the time for the most important spraying for codling moth. Thoroughness of application at this time is absolutely essential.
(Purdue Experiment Station)

Fig. 4. A Little Too Late to Spray for Codling Moth.
(Purdue Experiment Station)

Potato growers are advised to pay particular attention to the matter of preventing Rhizoctonia infection on potatoes. Scab should also be prevented.

For Rhizoctonia, it will be noted that the calendar advises the dipping of potatoes for three hours in a 1 to 2,000 water solution of corrosive sublimate. This will also prevent scab infection.

Treated potatoes should never be eaten or fed to animals. Formalin is the regular treatment for scab, where Rhizoctonia is not present. Prevention of these diseases by dipping the tubers to be used for planting is the only treatment outside of rotation in crops, which is also advised.

It must be understood that the calendar does not contain all the information that

Fig. 3. A Few Days After the Petals Fall, the Calyx Lobes Close Up, as They are Beginning to do Here. The second spraying of the orchard should be finished before this time.
(Purdue Experiment Station)

Fig. 5. The Time for the Third Spraying Three or Four Weeks After Petals Fall.
(Purdue Experiment Station)

Fig 6. Twigs Sprayed with Lime-Sulphur. Spraying should be done thoroughly. The unsprayed surface of the twigs to the right might harbor many scales.

(Purdue Experiment Station)

may be needed at times. Now and then minor troubles on special crops appear and require treatment not given in the calendar.

Again, a disease, although important in itself, but having a very limited distribution and of little general interest, could not be given space in a calendar. As an instance, the rust of apples and pears is omitted for the reason that it is not, as yet, generally serious.

To read the spray calendar, read right across two pages. When it is determined what you wish to spray for, follow the line to the next column, which tells what to use; then read the notes following the same line. Very often the notes give just the information needed, and also refer to the formulae and directions for use.

How to Spray

Use plenty of pressure, 200 pounds or more is better than lower pressure. Apply thoroughly, drenching every part of the tree. Do not try to save by economizing on spray. If your trees are tall, use a tower and spray down from it. Examine trees after they are sprayed, especially for codling moth spraying, and see that poison has entered the calyx cups. Nothing short of good work should be tolerated. Do not think that a spray applied out of season will be effective. A spray is only effective when applied at the right time. Sprays are not "cure-alls." Use the spray suited to the case in hand.

WHEN TO SPRAY	WHAT TO SPRAY FOR	WHAT TO USE
SPRING (1) When buds are swelling.	Rosy Apple Aphis. Green Apple Aphis. Woolly Aphis. Green Peach Aphis Cherry Aphis.	Black Leaf 40, 1-800, combined with Lime Sulphur, 4.5 degrees Beaume.
	San Jose Scale. Blister and "Rusty Leaf" Mite of Pear. Eggs of Red Spider. Erinose Mite of Grape. Peach Leaf Curl. Peach Bud Moth. Moss and Lichens.	Lime Sulphur, 4.5 degrees Beaume.
	Raspberry Cane Blight.	Resin Bordeaux mixture.
	Apple Mildew. Rose Mildew.	Atomic Sulphur— 7 pounds to 50 gallons water.
(2) When bud scales are opening.	Apple and Pear Scab.	8-8-50 Self-boiled Lime-sulphur or 7 lbs. Atomic Sulphur; 50 gals. water.
	Pear Thrips. (Other species of Thrips.)	Distillate Oil Emulsion, combined with Black Leaf 40.
(3) Just before blossoms open.	Cherry Fruit Sawfly. (Attacks Cherries, Prunes, Plums.)	Arsenate of Lead— 5 lbs. to 100 gals. of water.
(4) When last petals are falling and before calyx closes in.	Codling Moth on Pears and Apples.	Arsenate of Lead— 4 lbs. to 100 gals. of water.
	Apple and Pear Scab.	8-8-50 Self-boiled. Lime-sulphur or Atomic Sulphur, 7 lbs. to 50 gals. of water.
	Apple Mildew. Apple Alternaria (blossom-end).	Atomic Sulphur— 7 lbs. to 50 gals. water.
(5) About first week in May.	Peach Blight or "Shot-hole." (Also attacks Apricots and Almonds.)	8-8-50 Self-boiled Lime-Sulphur, or Atomic Sulphur, 7 lbs. to 50 gals. of water.
(6) When they appear.	Twig Borer, Caterpillars. Spring Canker Worm.	Arsenate of Lead— 4 lbs. to 100 gals. of water.
SUMMER When pests appear.	Aphides (apple, pear, cherry, etc.) Woolly Aphis on limbs and branches. Red Spider. Erinose Mite of Grape. Oyster Shell Bark Louse. Leaf Hopper. Aphides on truck crops. Green Peach Aphis. "Rusty Leaf" Mite of Pear. Apple Tingis.	Tobacco Black-Leaf— 1 to 65; or Black-Leaf 40 (Sulphate of Nicotine) 1 to 800 or 1 to 1,000. Dry Sulphur or Atomic Sulphur for Mites and Red Spider. Soap Solution— 5 lbs. hard soap to 50 gals. water.
	Pear and Cherry Slug.	Arsenate of Lead— 4 lbs. to 100 gals. of water; or use road dust, lime dust, or ashes.
	Caterpillars. Striped Cucumber Beetle (Diabrotica.)	Arsenate of Lead— 4 lbs. to 100 gals. of water.
	Root Maggots, etc.	Carbolated Lime.
	Squash Bugs.	Whale-Oil Soap and Quassia; Kerosene Emulsion.
	Grasshoppers. Cutworms. Flea Beetle.	Bordeaux Mixture as a repellent.
	Potato Blight.	Bordeaux Mixture, 5-5-50.
	Codling Moth. (See note.)	Arsenate of Lead— 4 lbs. to 100 gals. of water.
FALL Before fall rains begin	Raspberry Cane Blight.	Resin-Bordeaux.
	Apple Anthracnose. Peach Blight, or "Shot-Hole."	Bordeaux Mixture, 5-5-50.

NOTES.

Combination of Lime-Sulphur with Black Leaf 40 for Aphides only. Add Black Leaf 40 to the diluted Lime-Sulphur at the rate of 1 pint per 100 gallons.

For woolly aphis, do not fail to spray bodies and crowns thoroughly. It is a good plan to uncover roots, at least one foot from crown, and drench thoroughly.

Peach moth may also be controlled by applying arsenate of lead, 4 pounds to 100 gallons of water, when blossoms are opening.

Spray first before the leaves appear; second, when the leaves are well out and the young shoots are about six inches in height; third, just before the blossoms appear. See formulae.

See formulae.

Force spray well into fruit bud clusters.

Pears, peaches, cherries, prunes, are all attacked by this insect. Write for Circular No. 131, Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C. See formulae.

Thoroughly cover with spray the unopened blossoms. Do not spray during bloom. Another application after "shucks" have fallen.

Use a nozzle with an angle of 45 degrees, and spray with pressure of 175 to 200 pounds. See that every young fruit has had spray forced into the calyx cup. Spray should be coarse and, if trees are tall, a platform on the spray tank should be used. Pears need not be sprayed until apples are ready, as pear calyces remain open. Repeat the above in a week or ten days on apples only. All moths do not emerge from their cocoons at the same time. Band some trees with cloth; the number of worms caught will indicate the effectiveness of the above treatment. Later sprays should not be coarse, but a fine mist, to cover fruit and foliage.

To be combined with arsenate of lead spray above where scab occurs. Another application two or three weeks later may be necessary in certain seasons.

To be combined with the first codling moth spray. Another application may be necessary.

Do not apply within a month of picking, as fruit will be stained. To be applied where fall spraying with Bordeaux mixture has been omitted. A second treatment the latter part of May if necessary. See formulae.

The first codling moth spray will be more or less timely.

Be sure to spray as soon as the colonies of the insects appear. In the case of aphides it is very difficult to eradicate them after they have curled the leaves badly. Remember this is a contact spray and the insects can only be killed by direct contact with the insecticide. The black-leaf may be mixed with arsenate of lead, if necessary, to save labor of double spraying, where aphis and codling moth are to be controlled at the same time. For red spider, erinose mite of grape, and "Rusty Leaf" mite of pear, dry sulphur, atomic sulphur or self-boiled lime-sulphur may be used. The soap solution may be combined with the black-leaf to make it adhere better. *Never combine soap and arsenate of lead.*

Do not spray on ripe fruit, as spray is poisonous.

All vegetables sprayed with arsenicals should be carefully washed in preparing them for the table.

Formula for carbolated lime: 10 pounds of lime; water, 50 gallons; carbolic acid, 1 pint or more. Slake lime with a little water, add rest of water and the carbolic acid. Work the mixture into the soil.

Clean culture is important. All rubbish in the field and along fences should be destroyed. Fall plowing should be practiced. Insects may be trapped by placing shingles or boards among the vines. In cucumber and melon fields damage from squash bug may be lessened by the use of squash vines planted a week or so earlier between the other hills as trap plants. For the young insects spray as indicated.

For cutworms, kainit, which is a potash fertilizer, is effective.

For grasshoppers, it is usually necessary to cover young trees with cheesecloth where they are numerous. This should be done promptly upon first appearance. Pyrethrum powder may also be used for flea beetle.

Spray thoroughly first week in June and two or three weeks later if necessary.

Third application dependent upon season, but usually latter part of June. An application the latter part of July is usually necessary. If the calyx spraying is well done, few worms will be left for the last two sprays.

After the field has been thoroughly cleaned up, spray before the rains begin. See formulae.

Be sure to spray all stone fruits as well as apples before fall rains begin. Do not wait for leaves to fall. Fall spraying for pears unnecessary.

	PESTS.	WHAT TO USE.
Insect pests, fungous diseases and other troubles controlled by various means	Pear Blight. (All species of the pome family.)	Use Corrosive Sublimate, 1 to 1000, as a disinfectant.
	Raspberry Cane Maggot.	No spray remedy.
	Potato Rhizoctonia.	Corrosive Sublimate, 1 to 2,000.
	Potato Scab. Smut of wheat, oats, barley.	Formalin— 1 pint to 30 gallons of water.
	Cabbage Worms.	Paris Green 1 part, bran 40 parts.
	Climbing Cutworms. Garden Cutworms.	Paris Green 1 part, bran 40 parts. (By weight.)
	Wireworms. (Larvae of Click Beetle.	Poisoned slices of potato, Black-Leaf 40, Tar.
	Grape Mildew	Atomic Sulphur, 7 pounds to 50 gallons water; or Flowers of Sulphur.
	Tussock Moth.	Bands.
	Flat-headed Borers. (Apple, pear.)	Wrappers. Shades.
	Peach Borer (crown and root of peach, prune, almond, apricot.)	Poison Wash or Hard Asphaltum, grades "C" or "B."
	Asparagus Rust.	Atomic Sulphur, 7 pounds to 50 gallons of water; or Flowers of Sulphur.
	Strawberry Crown-borer, and Root-borer.	No remedy to save affected plants.
	Wilt diseases of Tomato, Melon, Cucumber, Cantaloup, Potato, Squash, Cow Pea and other garden vegetables.	Rotation in crops.
	Ants.	Tartar Emetic 1 part, syrup 60 parts; or Fumigation.
	Gophers.	Arsenic, Carbon Bisulphide or Calcium Carbide.
	Rabbits and field mice.	Otwell Tree Paint.
	Rabbits, ground squirrels, moles.	Strychnia Sulphate— traps for moles.
	Poultry mites and lice.	Strong Lime-sulphur. Dust baths. Carbolic Acid solution.
	Bedbugs Cockroaches.	Corrosive Sublimate.
	Fumigation of nursery stock, fruits, grains, feeds, insect infested rooms and buildings	Fumigation— 1 oz. Potassium Cyanide 98 pct. 1 oz. Sulphuric Acid, 2 oz. water.
	Alfalfa Crown Gall (*Urophlyctis*).	No spray remedy.
	Crown Gall (*Bacterial*).	Destroy infected plants.
	Insects in stored grains and fruits.	Carbon Bisulphide. Fumigation.
	Disinfection of all seeds.	Formalin.
	Weeds.	Iron Sulphate (Copperas)— 20 per cent solution.

NOTES.

There is no spray remedy for this bacterial disease. Carefully remove all infections in the bodies, limbs or roots before the blossoming season opens. If blight appears during the growing season, *remove it,* using great care to cut well below infection point. Wipe the instruments and cuts with corrosive sublimate (bichlorid of mercury) 1 to 1000. This is the most serious of all orchard fruit diseases and the one most to be guarded against.

Cut out and burn all infested canes.

Soak three hours. *Never use treated potatoes for food.*

Soak the potatoes before cutting for two hours. Do not plant potatoes in ground from which scabby potatoes have been dug. Rotate with other crops.

Sprinkle the grain thoroughly, mix on a bin floor, let dry and sow.

Mix well. Dust the plants well before worms eat in. If plants are heading, use white hellebore, one ounce to two gallons of water.

Make a mash by adding some water; add a little molasses and salt; mix and scatter in small piles among plants or in bed before planting. Be careful that chickens do not get at the poison. Black-leaf 40 (1 to 800) may also be used to saturate the ground.

Poisoned slices of potatoes may or may not be readily eaten. The use of black-leaf 40 (1 to 800) applied to the ground about the plants will drive them away. See formulae.

Dust the sulphur on the vines frequently during the summer. If applied while dew is on the vines, it will adhere much better. Atomic Sulphur spray more effective.

Band the trees with "Tree Tangle-foot." Tar or other sticky preparations should not be applied directly to the bark of trees.

Wrap young trees with heavy building paper at least a foot above ground, and have wrapper extend two or three inches below surface. Young pear trees are not troubled so seriously. It is also a good plan to shade the trees by driving a shake into the ground on southwest side. Place shake three to four inches from tree. Inter-cropping with corn also effective.

Use wash made as follows: 5 gallons whitewash; 1 pint liquid glue; ½ pint carbolic acid; 1½ ounces Paris green. Apply about May 1st. This remedy is not entirely effective, and trees should be examined for borers. Another treatment is to apply two coats of warm asphaltum with brush in spring to trees after borers have been dug out. The asphaltum coat may reach five inches below to five inches above the ground.

Three weeks after cutting stops, spray with whale oil soap and water (6 pounds soap to 50 gallons of water), then dust with flowers of sulphur at the rate of 100 to 150 pounds per acre. A month later, apply on dewy mornings, 150 to 200 pounds of flowers of sulphur per acre. Atomic Sulphur spray more effective.

There is no known remedy. Destroy infested plants before May 1st. Do not replant in infested ground.

Do not plant in soils in which diseased plants have grown. Practice rotation with other crops. Use corn, small grains for at least two years, then plant only carefully selected clean seed.

Mix well together and leave where ants can feed upon it. The ants will go to their nests after eating and will die. Species which are cannibalistic will be killed upon eating the poisoned ones which return to the nests.

Cut potatoes or carrots in two lengthwise. Spread arsenic on cut surface and pin the parts together with toothpicks or sharpened matches. Put poisoned vegetable in ground where gophers are working.

Liver rubbed on trunks will also act as a repellent. Otwell Tree Paint is a good repellent.

Rabbits and ground squirrels may be poisoned with strychnia sulphate. This poison may be applied directly to apples where they will be eaten. There are also proprietary poisons purchasable at drug stores. Moles must be trapped.

Poultry houses should be thoroughly sprayed with a strong lime-sulphur solution, while the roosts may be washed with carbolic acid solution (six ounces of crude carbolic acid to one gallon of hot water). Dust baths may be of fine road dust, equal parts of sulphur and powdered tobacco or wood ashes.

Walls and furniture may be sprayed with 1 to 500 solution of corrosive sublimate in alcohol. Alcohol will dissolve paint or varnish on wood and water may be used instead. Where it is possible, fumigation is best. Use cyanide of potassium (98 per cent), one ounce, by weight; sulphuric acid (crude), one ounce, liquid measure; water, two ounces. Place water in earthenware dish; add the sulphuric acid and then drop the cyanide of potassium in. Get out of the room quickly, and close doors and windows tightly. Do not enter until room has been thoroughly ventilated. *This is a most deadly poison if inhaled, and great care should be exercised in its use.* The above formula is sufficient for 100 cubic feet of space. For fumigating greenhouses, it is sufficient for 350 cubic feet.

Plow up infected fields and rotate in grain for at least two years.

This is a bacterial disease of a large number of species of plants of widely separated genera. There is no cure or remedy. All plants, such as pears, apples, peaches, etc., found to be infected should be rejected. This disease is more serious in our dry regions.

Place in shallow dishes in the bins. The gas, being heavy, will go downward. Or use potassium cyanide as above.

See formulae.

This spray destroys mustards, dandelion, thistles, ragweed, and other broad-leaved plants.

SPRAYING CALENDAR

Prepared by JOHN G. HALL, Plant Pathologist, and M. A. YOTHERS, Assistant Entomologist, Washington Experiment Station. There is no spraying that will kill everything. Use the ones that fit your case.

AFFECTING THE ROOTS—

NAME	DESCRIPTION	TREATMENT
1. Woolly aphis	Small galls containing mealy insects	Expose roots and wet with 1 per cent potassium cyanide solution or tobacco.
2. Grubs and wireworms	Feeding on the roots	No available treatment. Seek out and destroy insects
3. Gophers	Feeding on the roots	Trap; or poison with raisins containing strychnine placed in runways.
4. Hairy root	Excessive development of fine roots from a large root	No remedy except careful nursery inspection. Do not plant affected stock.
5. Crown gall	Smooth to warty swellings of various sizes	No remedy except careful nursery inspection Do not plant affected stock
6. Crown-rot	Dead, sunken bark at crown of tree	Avoid forcing the growth of young trees

AFFECTING THE CROWN OR TRUNK—

NAME	DESCRIPTION	TREATMENT
7. Rabbits and field mice	Gnawing bark in winter	Keep trunk coated throughout winter with thick whitewash containing strong lime-sulphur.
8. Borers	Tunneling beneath bark or into heartwood	Keep trunk coated throughout summer with thick whitewash containing strong lime-sulphur.
9. Canker	Irregular, discolored sunken areas usually cracked around edges	No remedy when these cankers are due to winter injury. If black-spot canker, November spraying with Bordeaux (6-6-50).
10. Black-heart	Heartwood dead and stained blackish brown	No remedy known.

AFFECTING THE BRANCHES AND TWIGS—

NAME	DESCRIPTION	TREATMENT
11. San Jose scale	Ash-gray or black, round scales, pinhead in size	Crude oil emulsion spray or lime-sulphur about March 1.
12. Oyster shell bark-louse	Slender bark-colored scales filled with eggs, which hatch about June 1 (one brood a year)	1. Tobacco when young are hatching (about June 1). 2. Lime-sulphur (3°), or crude oil emulsion spray, in fall or early spring.
13. Woolly aphis	Clusters of mealy lice, often near injured bark	Tobacco spray.
14. Orchard mite eggs	Microscopic salmon-red spherical eggs	Crude oil emulsion.
15. Aphis eggs	Minute oval jet-black eggs (winter)	Crude oil emulsion, or lime-sulphur (3°), before buds swell, or tobacco when plant-lice hatch.
16. Tent caterpillar eggs	Frothy mass encircling a twig	Crude oil emulsion before buds swell, or arsenical when caterpillars hatch.
17. Lecanium	Hemispherical brown scales	Crude oil emulsion before buds swell, or tobacco when scales hatch.
18. Cottony scale	Brown scales that develop cottony mass in the fall	Crude oil emulsion.
19. Cicaa and tree cricket	Twigs slit to contain eggs	Prune off infested twigs before eggs hatch.
20. Bark beetle	Tunneling under bark	Not likely to attack vigorous trees. No immediate treatment.
21. Lichens	Popularly known as moss	Winter spray with lime-sulphur (3°).
22. Gummosis of cherry	Glistening mass of amber-colored gum upon branches	Caused by scale, bacteria, aphis, over-irrigation, etc. Remedy depends on cause.
23. Fire-blight of pear and apple	Dead leaves and fruit hanging to blighted branches; blackish, water-soaked cankers	Prune away dead and blighting branches and wash pruned surfaces with 1 part of corrosive sublimate to 1000 parts of water. See *Popular Bulletin* No. 56.
24. Winter-kill or die-back	Death of twigs or branches from tip downward	No remedy. Remove dead wood. Avoid late irrigation.
25. Peach blight	Spotting of green twigs and formation of a gum	Prune out dead twigs. Spray in winter with oil emulsion.

AFFECTING THE BUDS, NEW LEAVES, OR BLOSSOMS—			
26.	Bud weevils	Hard-shelled beetles that drop when disturbed	Use inverted cone tree protector of stiff paper or tin.
27.	Cutworms	Work at night; live in ground during day	Coat tree with Bordeaux. Scatter poison mash on ground near tree.
28.	Ants	Eating buds, young leaves, and blossoms	Pour 1 per cent potassium cyanide solution in nest (deadly poison).
29.	Budworm, twig borer	Working in terminal growth furling leaves. A small brown spinning worm	1. Crude oil emulsion, or lime sulphur (3°), before buds swell. 2. Arsenate lead when injury noticed.
30.	Snapping beetle	Feeding in the blossoms	No treatment.
31.	Chafer beetle	Eating through the blossoms	No treatment.
32.	Salmon fly	Feeding in the blossoms	Spray with arsenate of lead.
33.	Thrips	Minute, active, slender insects	Tobacco.
AFFECTING THE FOLIAGE—			
34.	Tent caterpillars	Working from web nests	Spray as soon as caterpillars appear with arsenite of zinc, or burn with torch.
35.	Tussock moth	Caterpillars covered with bunches of hairs	Spray as soon as caterpillars appear with arsenite of zinc.
36.	Red hump caterpillar	Striped caterpillars with red head and collar	Spray as soon as caterpillars appear with arsenite of zinc.
37.	Grasshopper		Spray with Bordeaux. Scatter poison mash about orchard.
38.	Climbing cutworm		See No. 27.
39.	Pear and cherry slug	Slimy caterpillars feeding on upper surface of leaves	Spray with arsenate of lead, or dust with lime, ashes, or road dust.
40.	Black aphis	On cherry	Spray early with tobacco, before leaves curl.
41.	Green aphis. Pink aphis		Tobacco (summer), or lime sulphur (3°), or crude oil emulsion in winter. See No. 15.
42.	Blister mite	Red, brown to black spots; on pear	No summer treatment. Crude oil emulsion or lime sulphur when dormant.
43.	Leaf hopper. Tingis	Sucking insects producing yellow spots in leaves	Tobacco spray. Use high pressure and disk nozzle to form mist.
44.	Orchard mite	Causing leaves to yellow	Tobacco when noticed. See No. 14.
45.	Peach leaf curl	Leaves puckered, becoming rose-colored or purple	Spray in winter and early spring before leaves appear; use lime-sulphur.
46.	Powdery mildew	Whitish patches on leaves, twigs and fruit	Spray with self boiled lime sulphur.
47.	Rosette	Cessation of twig growth and rosetting of leaves	No remedy known.
48.	Shot hole diseases	Brown spots on leaves, later falling out	Spray with lime-sulphur during dormant season.
AFFECTING THE FRUIT—			
	I. Infesting Outside of Fruit:		
49.	San José scale	Usually surrounded by red ring	No summer treatment. See No. 11.
50.	Oyster shell scale	Shaped like miniature mussel shell	Tobacco when young hatch (about June 1).
51.	Caterpillars	Several species may nibble on skin	Arsenate of lead as soon as injury is noted.
52.	Apple scab	Dull greenish black patches on leaves and fruit	Spray with Bordeaux (4-4-50) just before blossoms open; lime-sulphur (1.5°) after petals fall, and repeat after 10 or 14 days. Destroy all fallen leaves.
53.	Brown rot of prunes	Small circular brown spots, later giving rise to spore-tufts	Destroy all mummied fruits; spray with lime-sulphur in summer.
54.	Fruit spot of apricot	Brown, hard sunken spots or elevations	No remedy known.
55.	Baldwin speck; fruit spot	Skin spots appearing before harvest, working into fruit	No sure remedy known.
	II. Infesting Inside of Fruit:		
56.	Codling worm	The common worm in apple or pear	Spray with arsenate of lead, 1 lb. to 50 gals. of water, using Bordeaux nozzle with crook. Spray with force from a raised platform into every flower. Repeat immediately. If so applied, these sprayings are often sufficient. Keep a few trees banded. If many worms are trapped, spray about two to six weeks after first application.
57.	Peach worm	Same insect as twig borer	No satisfactory summer treatment. See 29.
58.	Apple saw-fly	Green caterpillar mining in fruit	No known treatment.
59.	Water core		Do not leave too long on trees.

Compatibility of Insecticides and Fungicides

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The cost of spray materials is no small item, but is usually insignificant as compared to the cost of application. One way of reducing the latter expense is by combination spraying, that is, by mixing two or more spray materials and applying them together. In mixtures of this sort grave chemical changes may take place which render the mixture wholly unfit for use. On the other hand, the original ingredients may remain unchanged or may be improved by their new associates.

Numerous experiments have been made to determine the advisability of combination sprays, and the results have been published in the bulletins of the United States Department of Agriculture, the state experiment stations and in agricultural journals. These reports are scattered through so many publications, and the conclusions are at times so conflicting, that no inconsiderable amount of time must be spent in a search of the literature to arrive at a definite conclusion as to the suitability of applying some particular remedy in combination with another.

In order to bring this information into more available form and of more easy access, it has been condensed into the form of a compatibility table.

Compatability Table—Insecticides and Fungicides

	Fungicides			Contact insecticides				Alkalies	Acids
	Bordeaux	Lime-sulphur	Iron sulfid	Cyanid fumigation	Tobacco	Soaps	Emulsions		
Stomach poisons, arsenical									
Paris green	A-1	D	A-1	D	?	D	D	D	D
Calcium arsenite	A	D	A		A	D	D	D	D
Lead arsenate (acid)	A-1	?	A-1	...	A	D	D	D	C
Lead arsenate (neutral)	A	B	A	.	A	A	A	A	D
Zinc arsenite	?	D	A-1		A	D	D	D	D
Contact insecticides:									
Lime-sulphur	?	.	..	A	A	C	D	C	C
Emulsions	?	D	C	. .	A-1	A	.	D	D
Soaps	A-1 or B	C	C	....	A	.	A	A	C
Tobacco	C or D	A	A	A	.	A	A-1	A or B	A
Cyanid fumigation	D	A	.	...	...	.	...	...	...
Acids	D	C	D		.	.		C	...
Alkalies	B	C	D				.	..	...

KEY TO CLASSIFICATION

A-1 Better results by mixing.
A Properties not changed by mixing.
B Efficient, non-injurious.
} Compatible.

C Inefficient, non-injurious.
D Dangerous mixtures.
} Incompatible, chemically.

Definitions

The word "compatibility" or its opposite "incompatibility" may seem odd as used in this connection, but it seemed to be the best word that presented itself to be applied in the sense to be later described. "Incompatibility of temperament" is a phrase often seen in the newspapers and its meaning may be described as a state of affairs in which trouble is precipitated whenever two opposing tempers come in contact. Incompatibility is the state of being incompatible. In pharmacy, the terms are often used, and usually a whole chapter is devoted to the subject in works on the practice of pharmacy. As applied to medicine, incompatibility is of three different types and may be defined as follows:

Incompatible

(1) Chemically—Not capable of being united in solution without liability to decomposition or other chemical change.

(2) Therapeutically—Not suitable to

be prescribed together because of opposing medicinal qualities.

(3) Physically—Not suitable to be mixed on account of liability to produce undesirable physical change.

In a broad sense, it seems that the word may be applied to insecticides and fungicides. The distinctions made between the different sorts of incompatibilities as applied to pharmacy might also be applied in a general way to spray mixtures. To avoid technicalities, however, it seems best to divide mixtures of insecticides and fungicides into five classes designated by letters.

CLASSIFICATION OF MIXTURES

The key to classification is briefly given at the bottom of the table for convenient reference. A little fuller statement is desirable and is as follows:

Class A-1

Compatible. Mixtures in which the chief constituents remain practically unchanged, but are less liable to decomposition after application, or in which an undesirable constituent has been neutralized or rendered less soluble. Mixtures in which the spreading or adhesive qualities are improved are also included in this class.

Class A

Compatible. Mixtures in which no important chemical or physical changes occur.

Class B

Incompatible chemically, but compatible in respect to use ("therapeutically" and "physically"). Efficient, non-injurious.

Mixtures in which important chemical changes occur but the original killing or preventive properties and physical properties are not impaired, and no injurious new compound is formed.

Class C

Incompatible chemically, and also incompatible in respect to use ("therapeutically" or "physically" or both). Inefficient, non-injurious.

Mixtures in which important chemical or physical changes occur and render a part or all of the original ingredients inert, or less active, or physically unsuitable for use, but not necessarily injurious to the host of the parasite.

Class D

Incompatible chemically, and also incompatible on account of injurious properties ("therapeutically" or "physically" or both). Dangerous mixtures.

Mixtures in which important chemical changes occur and render all or a part of the original constituents injurious to the host of the parasite.

NOTE—It so happens that D stands for dangerous and the table has been so arranged that dangerous mixtures are thus easily recognized by associating the letter which designates the class with the word.

Interpretation of the Table

The point must be brought out and strongly emphasized that it is not intended to recommend any particular mixture shown in the table in preference to any other. That is not the purpose of the table. For example: An A-1 mixture is not necessarily a better mixture to use than an A mixture. The comparison is not between the mixtures themselves but is intended to be made solely between the mixture and the original ingredients of the mixture; the classification is intended to show the effect of mixing only. It is seen by looking at the table that a Paris green Bordeaux combination is classed as A-1 and a neutral lead arsenate-Bordeaux combination is classed as A. This classification is not intended to mean that the fiirst combination is safer to use than the latter, but that the Paris green-Bordeaux combination is safer to use than Paris green alone, and that neither benefit nor harm results from the mixing of neutral lead arsenate and Bordeaux.

Classification tentative.

SPRAYING MACHINERY

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Spraying machinery has become of special importance during recent years through the interest in fruit growing aroused among farmers and fruit growers in general.

In harmony with the evolution of spraying, spraying machinery has been passing through a period of transition during the last decade, and pumps used for different kinds of spraying are rapidly becoming special purpose machines, designed to spray some certain crop or series of crops, which are treated in a similar manner. For example, this evolution has developed a traction machine of large capacity which will furnish liquids at high pressures to do grape, field and potato spraying thoroughly with a minimum of expense of labor and material. This is usually a two-wheeled, traction-power type of machine, in which the power is transmitted from the wheels by gears, chains, eccentrics, or cams, and the horse does the work instead of a man at the end of a pump handle.

Sometimes a man has made the acquaintance of some particular make of machine and knows its little faults so well that it may be better for him to retain this machine rather than purchase some simpler, less troublesome type of pump. On the other hand, in the present period of evolution in spraying machinery, it will often pay a man well to discard his old favorite for some more modern, more efficient type of machine which is better suited to his special line of work and better adapted to the particular conditions existing in his locality.

Factors to be Considered in Choosing a Spray Pump

Capacity, which involves: size, weight.

Simplicity, which involves: accessibility of part, ease of repair.

Durability, depending upon: quality of material, kind of material, workmanship, correct mechanical principles and designs, strength, weight.

Cost, determined by: capacity of pump, type of pump, amount of labor involved in manufacturing, material used, quality of material.

Capacity

A pump of larger capacity than is actually needed will always prove more satisfactory than one which falls short of the demands made upon it. As trees and orchards increase in size, the importance of having a machine which will enable the fruit growers to cover a considerable area quite rapidly becomes apparent. The grower must either purchase a new machine of larger capacity or look ahead at the outset, and provide for the future. Four acres of good bearing orchard is worthy of a power sprayer if the best results are desired, and nothing of smaller capacity than a large hand pump should be considered. A larger or smaller orchard will require a pump proportionately larger or smaller, but there is a limit for even the larger machines, and twenty acres of large trees is about all one large power sprayer was ever designed to spray.

Simplicity

Spray pumps should be as simple as possible, with a minimum of parts which ordinarily require attention. These parts should be easily replaced when worn, and should not be expensive when replacement becomes necessary. The ideal sought demands ease of repair, a minimum of parts, and these readily accessible, when worn, or not working properly. Leaky packing, clogged valves, worn-out valves, valve seats, cylinder liners, and plunger packings or cups must all be considered before choosing a pump that will fulfill its mission and serve the purpose for which it was purchased.

Durability

On the quality and kind of material, the excellence of the workmanship, together with weight and strength depends the durability or lasting qualities of the machine. Good design is also an important factor. Cheapness quite often means that inferior material has been used, and that inefficient or negligent laborers, who slight their work by accident or design, have been employed in the pump's manufacture.

Designers and builders of pumps often seem unwilling to adopt new ideas or better designs, and continue to build the same type of machine that they did ten or twelve years ago. Such machines will squirt liquid after a fashion but they do

not give the purchaser the returns desired with a minimum of expense for labor and repairs.

Some machines were never intended by their designers to pump gritty spray solutions, oil emulsions, caustic solutions, or acid oils in emulsion form, and consequently will not prove satisfactory. The efficiency of a pump depends largely upon the construction of its valves, valve-seats, plunger, cylinder and stuffing box, if built with the last. Air chambers are also very important, hence these subjects will be taken up under separate heads.

The body or frame of the pump should be heavy and strong enough to withstand hard usage and excessive strain. Bearings are often too short, gears too narrow and too light in weight, oil cups are omitted where they are needed, and the frame upon which the machine is mounted is so light that it is warped and buckled at every stroke of the pump.

Air chambers are often omitted on small pumps, and some large machines are equipped with very small ones. A barrel pump is greatly improved by the addition of an air chamber five or six inces in diameter and about two feet long. Intake and hose supply-pipes must be from a point near the bottom of the chamber, or the value of the resilient column of air is lost. The value of an air chamber lies in the even pressure obtained, in the taking away of the heavy shock upon valves, and of the sudden strain often put on other parts of a pump. A good air chamber also eases the labor of the man at the handle of the pump or of the engine which is furnishing the power. The liquid in the air chamber is often unagitated unless some provision in design has been made so that the opening of a nozzle cut-off agitates the liquid contained in the air chamber, in addition to the agitation caused by the supply of liquid being forced into the chamber.

Cylinders

Of cylinders we have several types, but no spray pump cylinder should be made of cast iron or steel except for spraying miscible oils and lime-sulphur solution. Brass tubing of heavy weight and threaded to fit the cylinder head is quite a common design. Some makers use a brass tubing cylinder clamped between the cylinder heads. Others use a solid cast chamber with some form of a brass liner or cylinder instead of the cast-iron one. The most durable and the one least affected by spray solutions is undoubtedly the heavy, cast-iron cylinder enameled with porcelain. The chief obstacle to the use of such a cylinder has been to get an even coat of enamel on the inside of the machined cylinder-casting, or a plunger-packing or cup which would have sufficient resiliency to adapt itself to the uneven wall of the cylinder. Some of the manufacturers seem to have solved this problem in a satisfactory way, while others claim it is but a partial success when used in the type of machine which they manufacture.

Valves

Kinds of valves are almost too numerous to mention if one takes into account the variations in each class. We may divide them into four classes: ball, poppet, swing-check and steam-check valves. For the first, three materials are used: rubber, steel and bronze, the latter material being, of course, the most durable for all-round work. Of the styles of poppet there are many which may be classified as follows: plain, square-faced poppet valves with rod-guide to hold them in position as in Fig 1 No. 1. No. 2 shows how uneven is the wear on such a valve. No. 3 shows a plain poppet valve with wing-blades to right it instead of a rod. No. 5 is a bevel-faced, wing-guided poppet valve, which approaches a large ball valve in durability and efficiency, when it is made so that it will rotate. No. 4 shows a modified form of a wing-guided poppet valve, with a rubber or leather ring to improve its efficiency in helping to retain the liquid above it. Fig. 2, Nos. 1 and 2 are ball valves.

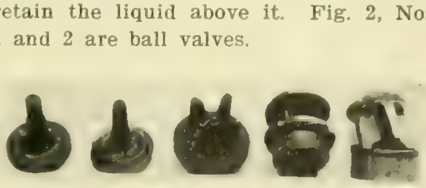


Fig. 1. Poppet Valves

Nos. 1 and 2 are about the desired size to give the maximum of durability and efficiency. The minimum size, shown in Fig. 2, No. 2, should not be less than three-quarters inch in diameter, and the upward range may extend to one and three-eighths inches in diameter, as in Fig. 2, for the maximum size, in large power pump. Small hand pumps may have ball valves as small as one-half inch in diameter. Poppet valves should be much larger in proportion to the amount of liquid passing through them than should the bronze ball valves. It is well to remember that, when the pump is running, the valve becomes as much lighter in weight as is the weight of the amount of liquid it dispatches, hence a much heavier valve can be used than a novice might suppose.

Fig. 2. Ball Valves.

Swing check and steam check valves are types designed for use in water and steam pipes. Both types work well in spray pumps when they are new, but their lasting qualities in a spraying machine are yet to be demonstrated. A flat face in any valve wears unevenly and makes a leaky valve when in combination with a flat valve-seat. Threads or waste sucked through the strainer often lodge across the square edge of the valve-seat and hold grit, hence the desirability of having bevel edges in valve-seats so that such material will not catch.

Valve-Seats

Valve-seats are built to receive the type of the valve used, and are made correspondingly cheap or costly. Iron valve-seats are common, and are usually found in ordinary well pumps. Some few makers use a rubber or leather ring as a secondary seat, which prevents back flow, through its elasticity, when the weight of the liquid or the pressure above holds the valve down. One company has equipped a pump with hard rubber valve-seats, but the majority of the manufacturers use a removable brass valve-seat. Strange to say, no company, so far as I know, seems to have tried to build valve-seats of the harder, non-corrodible alloys—that is, those not affected by spray solutions. In valves, a large part of the wear is on the valve-seat, especially in the case of the bronze-ball types. The ball may wear some, but constant turning keeps it a perfect sphere, while the valve-seat is hammered and worn away at every stroke of the pump, making plain the desirability of using a harder metal for a valve-seat than is used for the ball. I think that any man who has had experience with pressure pumps will also concede that a large ball valve is the most efficient and durable type made, especially for gritty solutions such as many of the spray mixtures are known to be. Fig. 2 shows valve-seats, and the accompanying balls are on the left and right of the valve-seats.

Plungers

Plungers are fitted with various types of packing. Very few pumps are equipped by their makers with poor packing, but leather hardens so rapidly that it is almost worthless as a packing for a spray pump, and hence should not be used for plunger-cups when other material can be obtained. The following materials are used for plunger packings: hemp, candle-wicking, steam packing, paraffine canvas, cotton cloth reinforced with rubber, and various other packings which go under trade names. Most of the packings are treated with oils, graphite or paraffin, but this does not include those in which rubber has been incorporated. Plungers are usually designed to carry a special kind of packing, and they work better with that kind of packing than with almost any substitute. A packing that is cheap, easily renewed or replaced, and that will last for a considerable period of time without wearing away so rapidly that it requires constant attention to keep it in shape, is the most desirable.

Agitators

Agitators are a frequent source of trouble in spraying outfits, especially in power machines. Swinging paddles usually pose as agitators, or long rotary types are used in the bottoms of round tanks or barrels. These work very well in small tanks or barrels but are a decided failure in large tanks. The sliding agitator is the type used ordinarily in most power machines. Connections of the agitators to power are made in various ways, but the principle is much the same in different makes. The amount of power required to operate such an agitator is enormous, in proportion to the agitation one gets in an ordinary tank. Propeller agitators are much more efficient than other types, because of the higher speed at which they may be run, their durability, simplicity, light weight, small size, and neat appearance, all being in their favor; besides possessing these qualities, they agitate the spray liquid thoroughly, and require less power to operate them than any of the large, sliding types of equal efficiency. Jet agitators are often used on small hand pumps, but they are always inefficient and give very little agitation. A jet agitator, properly constructed, would give fair agitation, but I know of none which utilizes the shape of the tank helping to agitate the solution.

A number of hand pumps are patterned after the ordinary water force pump. With these the stuffing box is the source of so much friction that barrel pumps of this type should be avoided. Simpler types of pumps, without a stuffiing-box, should be selected. Plungers with a plunger-cup, or inside plunger-packing, require less power to operate them. Outside plunger-packing, or a stuffing box on the outside of the plunger, is another method used in order to facilitate packing and obviate trouble. Double-acting pumps must necessarily have the stuffing-box and plunger-packing too, but some of the strongest and most durable power pumps are of this type. Of the two latter types I have no particular choice, as each has its merits, and each requires about the same amount of care. The simple, single-acting pump with a plunger-cup or plunger-packing on the outside or inside, requires less attention than any of the other types, and is preferable to the other types.

Supply Tanks

Supply tanks are of various shapes and sizes, but the round-bottom tank is most used because it is easy to build and easily kept tight by merely tightening a few nuts on the clamp rod. Hoop tanks always dry out and give trouble. Square, rodded tanks are very good, but require more tightening of rods when they become leaky. They have some points of superiority in case the ordinary types of agitators are used, since these will agitate the solution better when it is driven into the corners of a square tank.

Nozzles

Nozzles are often a source of considerable trouble to the operator of a spraying outfit. Bordeaux nozzles throw an uneven flat spray, which is too coarse for most spraying. Vermorel types with medium caps throw a narrow-angle, fine spray, but they are of small capacity, are always catching on limbs and frequently clogging. Pressure at the nozzle cap is also much reduced by the narrow orifices and tortuous channels through which the liquid must pass. Nozzles utilizing the principle of the whirl caused by the liquid entering from the sides of the whirling chamber, do not reduce so much the pressure and force, and give a broader, finer spray, without reducing the speed of the liquid as it passes through the nozzle cap. They also allow the use of much larger orifices and abolish the trouble of nozzle catching on limbs. This brings us to the large types, which are made by a number of the companies, and, so far as I know, all of these types of large nozzles are good.

Factors Which Tend to Make a Nozzle Throw an Even Spray

One fault that manufacturers seem to have overlooked is the tendency of the large-type nozzle to throw the bulk of the spray in one quarter of the circle. This may be overcome by making more supply holes through the plate or top of

the nozzle under the whirling chamber. Nozzles with four holes through the plate, instead of two, throw an almost perfectly even circle of spray. These holes make the supply of liquid come from four quadrants instead of from one or two quadrants, and even up the spray passing out through the nozzle cap. The illustration of large nozzles shows one with a four-hole supply and another with four jetties around the holes and on the sides of the whirling-chamber which give the whirl to the liquid and make a fine, even spray, especially with the high pressure obtained from power outfits.

On an ordinary power outfit, two leads of hose should be used, a larger number seldom being of any great advantage in orchard work. The lead of hose to the man in the tower need be only fifteen feet long, while the man on the ground should have at least thirty feet, and forty feet of hose is not too much when spraying large trees. On hand or barrel pumps one lead of twenty-five or thirty feet in length does very well for all spraying work, or two leads of that length may be used when two men are on the ground.

High-pressure hose with long hose couplings and good hose bands are a necessity in spraying, for ordinary hose bursts under the high pressure to which it is subjected, and short couplings are always making trouble. Half-inch high-pressure hose is most used, but three-eighths inch is also good and is not so heavy. The latter is harder to get connections for, when they are lost or broken, and may prove a little small in capacity when one uses three large-type nozzles on the end of a spray rod.

Rods

Rods are made of iron pipe, brass pipe, and bamboo with a brass or aluminum tube running through the hollow bamboo. Aluminum-lined bamboo rods are lighter than any of the others and when properly reinforced at the ends are as strong as any bamboo rod put out. In length the rods should not be less than eight feet. Ten-foot rods are preferable and twelve-foot rods are often a necessity in order to reach the tops of high trees.

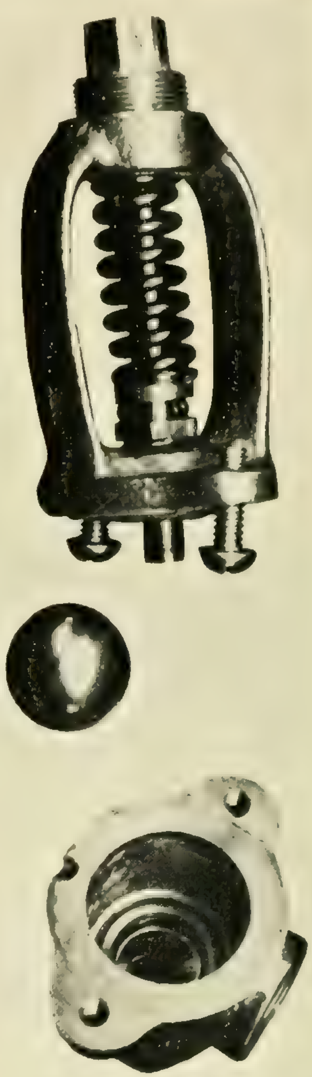


Fig. 3. Hardie Escape Valve Showing Compressor, Spring, Ball, and Seat. A neat, reliable and durable type of safety relief valve.

Longer rods are not often needed, and are cumbersome and hard to handle on account of their length.

Power Outfits

Power outfits should be chosen according to capacity and simplicity. Weight is a factor to be determined by the orchardist. His orchard may be hilly or level, and the size of trees and the kind

of usage a machine is to get will determine what sort of an outfit to purchase. Exteremely light outfits, in most cases, are not as durable as the slightly heavier types. Weight and strength have been sacrificed for lightness, but the durability of such an outfit is in some few makes of machines nearly equal that of the heaviest types. Type of pump, valves, etc., also figure largely in durability, but most of the leading pump manufacturers use bronze-ball or bevel-faced wing-guided poppet valves, so this factor does not enter so largely in the choice of a pump. Capacity, simplicity, efficiency, durability and cost, are the factors one must consider. Choose preferably a close-coupled truck, with fairly large wheels in the rear and smaller wheels in front, all wheels with broad tires, and with the spraying machine frame set low, using the wagon without a bolster in the rear, if possible, but with the machine set level.

Home-made power outfits are not advisable, as very few have the facilities for connecting up pump and engine satisfactorily. Special purpose machines may be built at home, and also a good hand or independent power pump outfit may be readily assembled.

Traction-power sprayers are for the most part special purpose machines. There are a few machines of this type built for orchard spraying but most of them were designed for spraying grapes, potatoes and similar field crops, or spraying for the destruction of weeds. Power is transmitted from the wheels by means of cams, eccentrics, chains or gears, and the pump is operated by these various mechanical contrivances. Here, as in the case of other types, the same factors, strength, simplicity, durability and capacity, must be considered.

Traction machines were designed as special purpose machines, and are not a complete success for orchard spraying. Some few machines can be operated as hand pumps as well as used as traction machines.

For the man who has a small orchard and needs a field sprayer, some machine of this type should be selected; but the fruit grower who has a large orchard must look to the other types for a more suitable machine.

Large hand pumps approach small power machines in capacity and are better than any barrel pumps on account of the long leverage that can be used. Two cylinders of smaller diameter are often used and the capacity is then greatly increased over that of the ordinary barrel pump. The entire weight of the body can be applied to the lever without stooping or bending the back, while any type of a tank or barrel can be used as the spray liquid container. For the man who cannot afford a power sprayer, or who has a medium sized orchard and can get cheap labor, this style is very satisfactory.

Barrel pumps of medium capacity are well suited to the small fruit grower or farmer who does not care to invest much money and yet wishes to raise good fruit. Medium capacity barrel pumps are to be preferred before the large capacity barrel pumps because the latter are hard to operate and it takes a heavy, strong man to pump one all day. Besides being useful for the man with a small home orchard, they may be successfully used for cold-water painting, whitewashing, spray-

Fig. 4. A Barrel Pump, Showing Agitator. A better type has valves, plunger and packing at the top where they are accessible, also an air chamber.

Courtesy W. B. Douglas

ing chicken coops to destroy mites, lice, etc.

Bucket pumps were never designed for spraying the apple orchard, but they are convenient for spraying truck crops, small trees and bushes around the yard, chicken coops, and doing many other small jobs about the home, where a small, convenient pump is needed. The Knapsack pump is a portable type of bucket pump, very useful for small work, and for spraying truck and garden crops.

Automatic sprayers are more convenient than knapsack sprayers, for they may be filled and then pumped up with air and the entire attention of the operator can be devoted to spraying without having to do the double duty of pumping and spraying at the same time. They are very convenient and readily carried about. For truck crops they are hard to beat when they are well made.

A fault of the larger part of the sprayers of this type is that they are made of galvanized iron and are corroded so rapidly by the Bordeaux sprays that they become worthless in a year or two. To be durable they must be constructed of heavy sheet brass, preferably seamless or with well riveted joints. For small work, a well-made sprayer of this type is almost ideal.

Compressed-air sprayers have some advantage, since they are easily operated and are of very simple construction. For such outfits the first cost of the charging and mixing plant and of the sprayer tanks is somewhat greater than that of the average power outfit having an equivalent daily capacity, so far as the amount of liquid sprayed out is concerned. The pressure, when using a compressed-air sprayer, must vary between two extremes, usually from 160 to 80 pounds while the tankful of solution is being discharged. This tends to make the work uneven, since the quality of the spray varies from fine to coarse and there is also a variation in the amount of liquid discharged in a given time. On the other hand, power outfits are operated under an almost constant pressure which is often as great as 200 pounds to the square inch.

Considering these facts and also that the amount of skilled labor required to operate either outfit is practically the same, I have reached the conclusion, after having operated both types of outfits in the field, that for the average orchardist, a power outfit is superior to the compressed-air outfit.

In either case the operator must possess average mechanical ability and exercise reasonable care.

Sprayers using compressed gas have the disadvantage of decomposing the lime-sulphur sprays. For killing scale insects, lime-sulphur spray is one of the best, and is almost universally used in orchard work.

Dust sprayers have been successfully used in treating cotton, tobacco and a few similar field crops. In general orchard work they have not proved a success, as has been demonstrated in extensive competitive tests against liquid sprayers. However, they have shown merit for such special use as dusting orange groves for rust mite. Their range of usefulness is evidently quite restricted.

In the following tables I have attempted to list the manufacturers who make various kinds of machines, so that an intending purchaser may write to those companies which build the kind of a machine he wishes to purchase, for catalogues and prices of the same.

In conclusion:

1 Choose a machine that has the factors of simplicity, durability and capacity and the efficiency of the machine will be unquestioned.

2 Cost is another question. A few dollars higher in price usually means better quality and "the best is the cheapest in the end."

3 Clean up your machine and accessories each time when you are through spraying.

4. Keep your machine in good trim, all bolts and bearings tight, plunger packed, etc.

5 Use good oil and plenty of it.

6 If something goes wrong and fails to work find out what the trouble is before you change any adjustments.

Changing adjustments without knowing why only means more trouble.

7 Results depend upon thorough work and the use of good standard brands of spraying materials.

ACCESSORIES

The accessories are taken up in their order of sequence, beginning with the preparation of the spray and following the liquid through its course until it is delivered on the trees. Before the liquid is poured into the tank it must always be strained, unless one is looking for trouble.

Strainers

Tank strainers, of the sloping-screen type, clog if the liquid is not poured on the upper end of the screen and allowed to wash the sediment to the lower end. A modification of the Stewart strainer, in which the liquid passes upwards through the screen from below, combined with the essential feature of the sloping-screen type, is shown in Fig. 5 (1). This type of strainer will not overflow under ordinary conditions, will not clog readily, and will usually drain out completely. It possesses all the advantages of the Stewart strainer with the additional value of the sloping-screen type of tank strainer. The screen should be of heavy brass cloth and have at least 14 wires to the inch. Wire cloth having more than 24 meshes to the inch is not strong enough to withstand the rough usage, and the fine mesh fills up with sediment and is hard to clean. A strainer of some kind is usually placed on the suction pipe or suction hose, but some machines are equipped with a metal box or well, attached permanently to the botom of the supply tank. This type permits the tank to be drained completely and a simple, easily cleaned strainer is enclosed in the well. These are furnished with only a few makes of machines. The usual types are shown in Fig. 6 (2) and (3).

Fig. 6 (2) and similar types always leave an inch or two of liquid in the tank and seemingly have no advantage over the type shown in Fig. 6 (3). The latter almost completely drains the tank and seldom clogs if it is at least four inches in diameter. These strainers should always be made of brass or some metal which is not corroded by any of the spray liquids. The iron strainers often seen on barrel pumps are entirely too small, and rarely last more than two or three seasons, even if the machine receives normal care. The screen on the suction-pipe strainer should be readily replaceable in case it is damaged in any way.

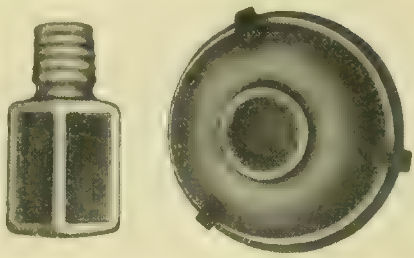


Fig. 6. (2) This kind of strainer will always leave several inches of solution in the tank. (3) A brass strainer with an easily replaceable brass screen of large area. A strong, durable accessory which permits practically the complete emptying of the tank by means of the suction hose.

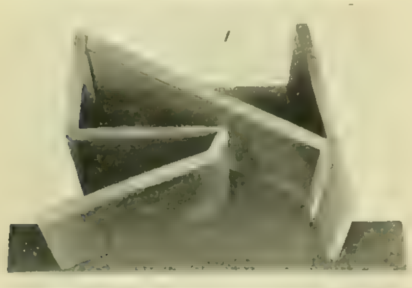
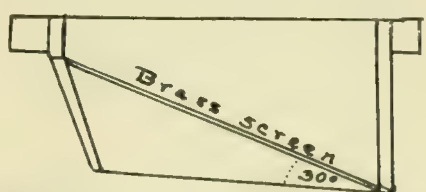


Fig. 5. (1) A home-made tank strainer of large capacity, having all of the advantages of the sloping-screen and Stewart strainers.



Sloping screen strainer

Fig. 7

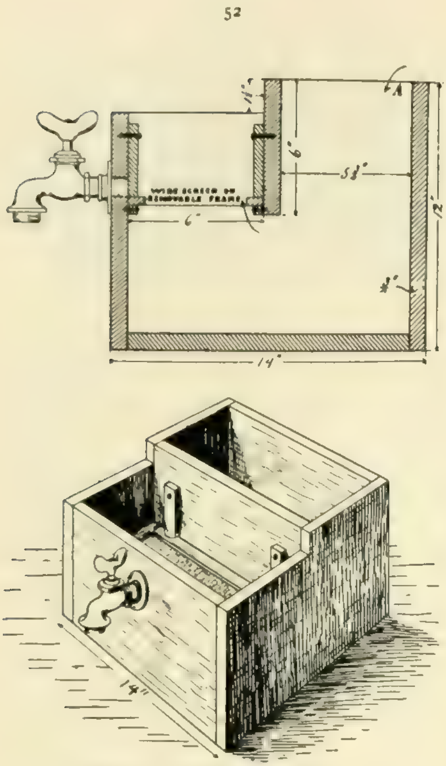


Fig. 8. Stewart Strainer.

Suction Hose or Pipe

The wire-lined suction hose, which is furnished with machines requiring such a connection, should be of the very best quality. One and one-fourth-inch pipe connections, although not flexible, nor as easily changed as the same diameter suction hose, possess the advantage of not becoming leaky, are not affected by the oil sprays, and cost very little when their replacement becomes necessary.

However, a suction hose permits the washing out of the pump without washing out the tank, and it is usually long enough to be placed in the storage tank when using a tank filler. Plain hose will collapse when the pump is operated, hence it cannot be used in place of wire-lined suction hose.

Air Chambers

The air chamber, in most cases, comes next in order. This serves a two-fold purpose; first, it acts as a storage for the liquid under pressure; secondly, the air confined above the stored liquid is a resilient body which tends to equalize the pressure when there is a sudden influx of liquid. When a pump has a large capacity per stroke, and is equipped with a small air chamber, it is not unusual to see the indicator on the pressure gauge swing through a range of fifteen to forty pounds at every stroke of the pump. The strain upon hose and connections is extremely severe, and the shock upon the closing valve is comparable to the blow from a hammer, when the pump is operated under these conditions. The capacity of the air chamber on power outfits should be at least one-half as great as the amount of liquid the pump delivers per minute when it is operated

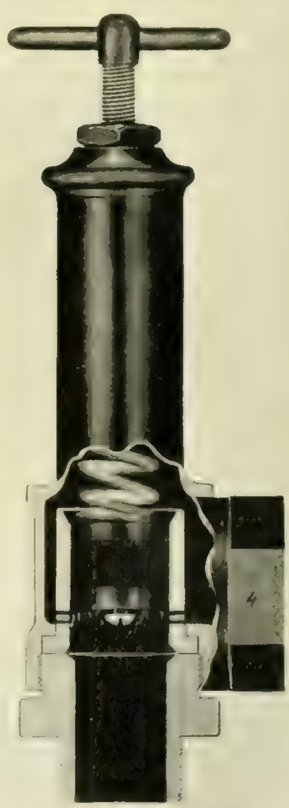


Fig. 9. (4) A simple plunger type relief valve which is very sensitive to pressure variation and has all of the apparent requisites of durability.

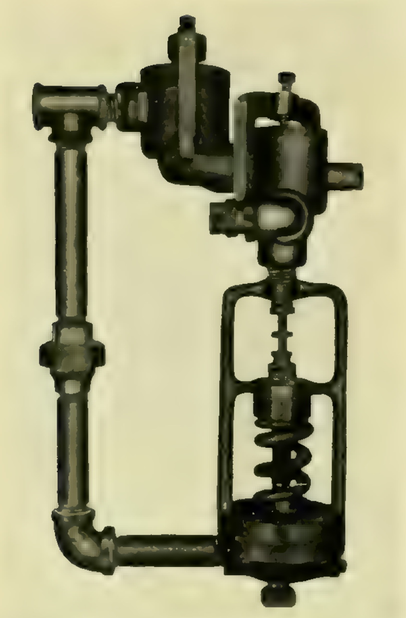


Fig 10. (5) A pressure regulator of a novel type which effects a great saving in power, prevents unnecessary wear, is positive in action, and has readily accessible parts.

at normal speed. Hand and barrel pumps should have air chambers which hold at least as much as the amount of liquid dispatched by the plunger per minute, while twice this size is better and is not too large. Traction machines need an air chamber having about twice the capacity of the pump in gallons per minute. The air chamber usually forms part of the pump, but most of the traction sprayers and a few of the hand and power machines have it separate. The better types of air chambers are made as light as possible consistent with the strength required, and some provision is made for agitation when the chamber is of large capacity.

Pressure Gauges

The pressure gauge is the index which makes possible careful and exact spraying when the remainder of the accessories are normally good. The operators of hand and barrel pumps are especially liable to overestimate the pressure they obtain while spraying. With hand or barrel sprayers, few operators realize how much the pressure varies, or how much it depends upon the degree of weariness the operator feels toward the end of the day. The work varies in thoroughness, and the spray in quality, whenever the pressure is allowed to run down below the normal working amount.

Relief Valves

Power and traction spraying machines must be equipped with a relief valve or pressure regulator in order to avoid accidents. The poppet types of relief valves, ordinarily furnished with power outfits, are not suitable for use on spraying machines where the spraying mixture contains grit and solid matter. When the valve is raised by the pressure of the liquid, it usually closes with a particle of sediment lodged between the broad face of the valve and its seat. This allows the spraying liquid to escape through the narrow opening at high speed, carrying with it particles of solid matter which soon channel or cut the face of the valve, and it becomes leaky and inefficient. If this type of relief valve had been designed especially for catching and retaining sediment, it could not serve the purpose better.

The ball relief valve has a narrow seat and the ball turns, giving a much greater surface with a shape which obviates any serious wear. When a relief valve having a small ball is used, it is of small capacity and of little value, as

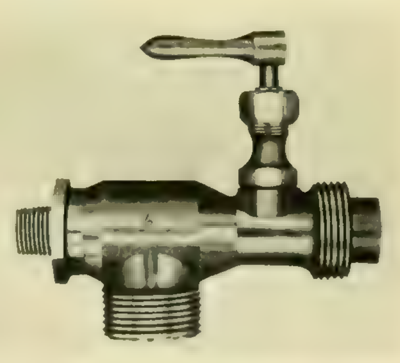


Fig. 11 (6) An ejector or jet pump of extremely small size but of large capacity. A simple piece of apparatus which lessens the labor of filling the sprayer tank, especially on power outfits.

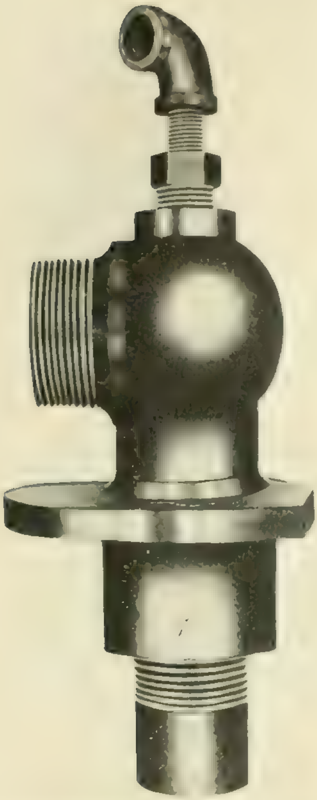


Fig. 12. (7) A tank filler which is so designed that it can be attached permanently to the sprayer tank.

it will not take care of the overflow when both leads of hose are shut off.

A plunger type of relief valve, which appeared on the market recently, is very sensitive to pressure variation and apparently has all ot the requisites of durability. When the pressure becomes great enough to overcome the forcing of a spring, the plunger is raised, uncovering a row of holes in the wall of the sleeve, through which the liquid escapes back into the tank. Fig. 9 gives a detailed view of its construction.

Several forms of pressure regulators, on some power and traction machines, automatically throw the pump out of gear, saving power and obviating trouble and danger when all of the pump's capacity is not utilized. This also effects a great saving in wear and prevents breaking the machine or straining it unnecessarily. Another form of regulator, which is placed on the suction pipe, shuts off the supply when the pressure becomes sufficient to raise the plunger against the spring. This allows the engine to run free, excepting for the vacuum created by the pump in pulling against a reduced opening or shut-off suction pipe, the expenditure of power and the wear of the machine being greatly lessened by this little device.

A special type of pressure regulator, which is placed between the pump and the air chamber, is operated by the liquid, under pressure, raising a diaphram against the spring regulator. The rod attached to the diaphram lifts the ball in the lower valve box, and the upper valve closes automatically. This retains the pressure in the air chamber and allows the liquid supplied by the pump to

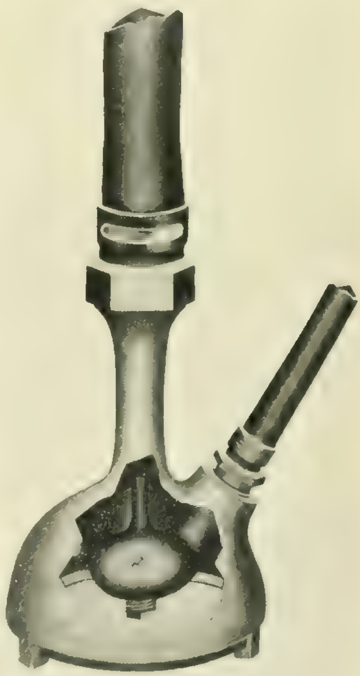


Fig. 13. (8) A tank filler which lifts the water above the high pressure jet stream. A convenient tank filler which can be left at the filling station.

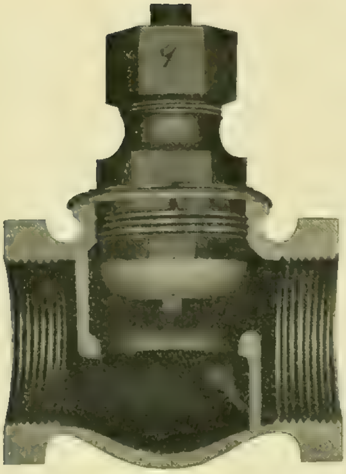


Fig 14. (9) A sectional view of a globe valve, showing the abrupt changes of direction the liquid must make and the broad faces of the valve and its seat where sediment is caught when the valve is closed.

pass under the lower valve into the tank. When the pressure in the air chamber is lowered, the lower valve closes and the upper valve is opened by the solution which is again forced into the air chamber. Fig. 10 shows the appearance of this regulator, which is large and heavy in comparison with the relief valves, but it is much superior to any of the other pressure-regulating devices for power sprayers.

Tank Fillers

Several forms of tank fillers, weighing from 40 to 200 lbs., were furnished with power sprayers of different makes several years ago. The lightest kind were rotary pumps which were of large capacity, but these pumps are not long-lived, as they must be run at high speed, and often pump water which is full of grit from ditches or ponds.

The jet pump or ejector types of tank fillers are supplanting most of the other kinds, as they have no moving parts to wear out or get out of order, and at the same time are light and convenient. They are operated by the pressure stream from the spray pump, which is forced through a reduced opening into a proportionally larger diameter pipe. The expansion of the jet of water creates a vacuum below the jet and lifts water in amounts proportional to the pressure and to the abundance of the supply. The height to which water can be raised depends upon the pressure furnished by the pump, and the height of the jet pump above the source of supply. If it is necessary to raise the water to greater heights than the ordinary suction hose permits, place the jet pump nearer to, or in the water to be raised. None of the fillers will raise water successfully by suction much higher than eighteen feet, but those placed in the water will lift it considerably higher than this, depending entirely upon the pressure of the supply to the jet stream. Three different types of tank fillers are shown in the illustrations. Fig. 11 is an ejector which may be used with steam or water; by connecting it up in a vertical position and turning on the pressure the water is raised. It is like Fig. 12 in that it depends almost entirely upon the vacuum created by the jet to raise the water. Fig. 13 shows a type which, when dropped into the supply, lifts the column of water above the pressure jet. Each type has desirable features, and the choice of kind must depend largely upon individual taste. When operated under 200 lbs. pressure, they will raise from twenty to forty gallons

Fig 15. (10) A simply constructed large leakless cutoff.

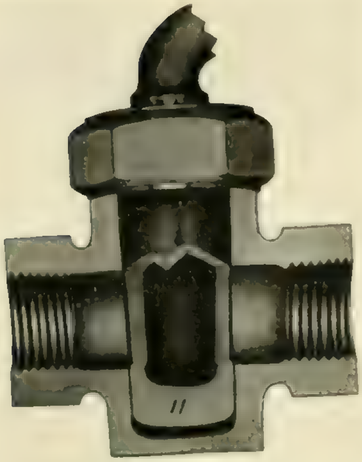


Fig. 16. (11) A sectional view of a leakless rod cutoff, showing the comparatively large, straight passage ways

per minute, depending upon the size of the jet pump and how high the water must be lifted.

Piping and Cut-Offs

The piping used to carry the spray liquid from the air chamber to some convenient point for attachment of the leads of high-pressure hose should be at least one-half inch in diameter and make as few turns as possible The pressure of the spray liquid at the nozzle is greatly reduced by friction of the solution against the walls of the pipe if the changes of direction are frequent, and if the size of the orifices through which it passes are small. The cut-off, at the point of attachment of the hose lead, permits the shutting off of one lead of hose whenever desired, and this takes unnecessary strain off the hose which is not in use. The three-way cut-offs, ordinarily furnished with machines, are always being turned in the wrong direction, with the result that some one is frequently drenched with spray liquid. Plain cut-offs are superior to the globe valves. See Fig. 14 (9). The latter usually change the direction of flow very abruptly, and soon become leaky, besides requiring a lot of time to shut off the hose lead. Gate valves are apt to become partially clogged with sediment, which prevents their closing properly, but they are superior to the globe valves, because they are of large capacity and do not change the direction of the flow of the liquid. The simple, leakless cut-off, shown in Fig. 15, is positive in action, easily operated, does not change the direction of the flow of the liquid, is readily adjusted or repacked, and is of large capacity. A sectional view of the leakless rod cut-off is shown in Fig. 16, giving an idea of the simplicity of its construction. Just under the cap-nut is a packing gland which allows any slack in the valve to be taken up, and also prevents any leakage.

Hose, Hose Connections and Hose Bands

The high pressures used in spraying with modern power spraying machines make the use of strong, heavy-walled hose imperative. Half-inch high-pressure hose of five, six, or seven-ply construction is generally used for this purpose. The heavier grades usually last enough longer, except where oil sprays are used, to warrant their purchase. Three-quarter-inch hose, having sufficient strength to

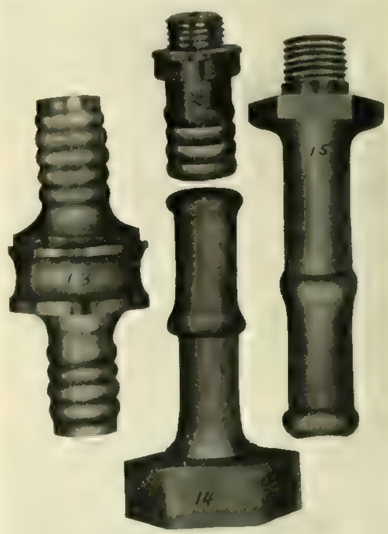


Fig. 17. (12 and 13) Single length hose connections with round nut. The kind every practical spraying outfit should not have. (14 and 15) Double length one fourth inch pipe thread male and standard female hose connections, permitting the use of two hose bands of the Sherman type. These have a hexagonal flange and hexagonal nut so they can be adjusted with an ordinary wrench.

withstand 200 lbs. pressure, is not practical to use, as it is too cumbersome, being entirely too heavy for the operator to drag around. Three-eighths-inch high-pressure hose costs almost as much as half-inch hose of similar quality, yet it does not have sufficient capacity to supply a cluster of large nozzles without greatly reducing the nozzle-pressure of the spray solution. The hose connections for this size of hose have much smaller openings than the half-inch connections, which partially accounts for the reduction of pressure at the nozzle cap. The lead of hose to the operator on the ground should be at least thirty-five feet long, but the lead to the tower can be as short as twelve feet without hampering the operator in handling the spray rod. Barrel pumps or large hand pumps will seldom successfully supply more than one lead of hose at a satisfactory working pressure; but two nozzles can be used on the spray rod, when one nozzle does not utilize more than half of the capacity of the pump. Fig. 17 (12), (13), (14) and (15) shows a number of the various styles of hose connections; the double-length kinds, permitting the use of two hose bands, are the only ones which should be used. A connection having a hexagonal nut of the form shown in (14) is superior to the round, coupling type (13). The flange or a corresponding section of the male hose connection should be hexagonal, as in (15), so that an ordinary wrench can be used to turn it, and when the connection at the base of the extension rod has one-fourth-inch pipe-thread, as in (15) and Fig. 18 (16), the reducer of the type shown in (17) is not needed.

The Sherman hose-band, shown in (18), is much superior to a wire or narrow galvanized iron band, and is the kind that is amost universally used. "Never-slip" clamps, like those shown in (19), are so built that the hose cannot be pulled off of the connection by pressure. The hooks on the clamp extend over the flange on the connection and supplement the clamp on the hose in preventing it from slipping off of the connection. For power sprayers this style of clamp and connection is superior to any other kind, as it is impossible to blow the hose off of the connection by high pressure.

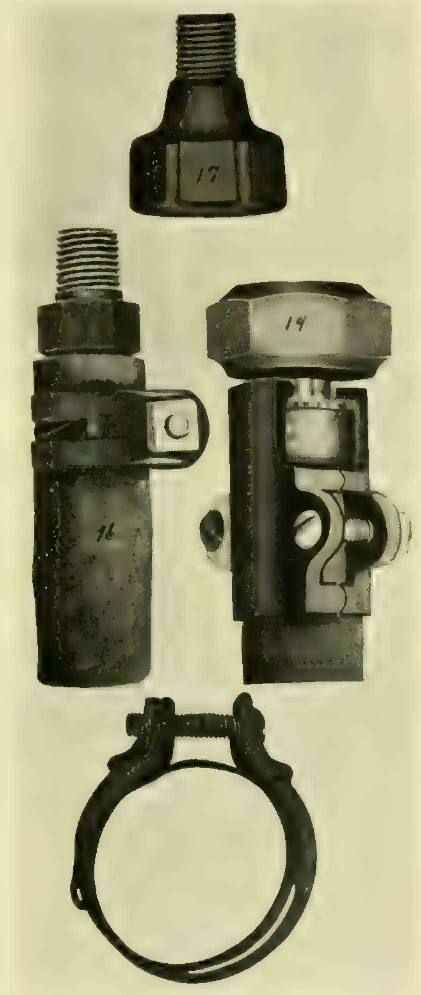


Fig. 18. (16) A one-fourth pipe-thread male hose connection with a hexagonal section and held by a single Sherman hose-band. This connection is long enough to permit the use of two hose-bands. (17) A reducer which becomes unnecessary when a one-fourth threaded connection is used instead of a standard male hose connection. (18) A Sherman hose-band. (19) A Never Slip hose-clamp and a double-length connection in position. The hexagonal nut is superior to the round kind often furnished.

Rod Cut-Offs

The one-fourth-inch cut-offs, used at the base of the spray rods, must have sufficiently large openings so that the flow

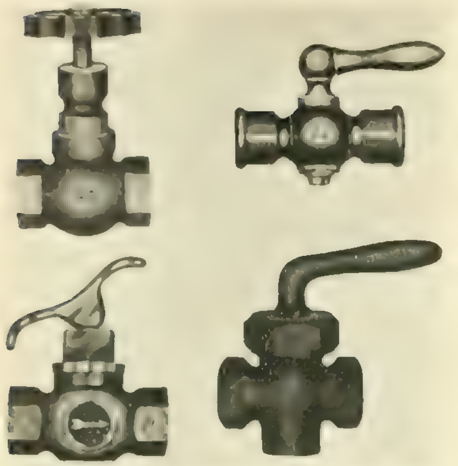


Fig. 19. (20) A one fourth globe valve. (21) A small capacity one fourth inch spring cut-off with ways similar to the globe valve. (22) A one fourth inch steam cut off of small capacity. (23) A one fourth inch leakless rod cut off which is simple in construction, positive in action, and of a practical size.

of the liquid is not obstructed. The globe valve shown in Fig. 19 (20) has fair capacity, but changes the direction of the flow of the liquid too often at very sharp angles, also it closes slowly and soon becomes leaky; (21) has some similar faults, but serves the purpose better for small sprayers, as it acts quickly in cutting off the spray. The cut-off shown in (22) is of very small capacity and soon becomes leaky. A ball cut-off, which was tested for several seasons, did not prove entirely satisfactory, as it was a little clumsy and cumbersome. The gate valve cannot be closed quickly, although the ways are large. The leakless cut-off shown in (23) is simple, easily operated, and is positive in action. The ways are large, permitting the flow of the spray liquid without changing its direction, and if it becomes leaky, it is easily repacked. The use of this little accessory prevents, each season, the wasting of enough spraying mixture to pay for it many times.

Spray Rods

Extension rods are necessary for spraying large trees, since most of the modern spray nozzles produce a fine mist spray which has very little carrying power. For small orchards a section of one-fourth-inch iron pipe serves the purpose very well, if the rods needed are not over six or eight feet in length. Longer lengths of one-fourth-inch iron pipe are hard to handle on account of their weight, and they often break off in the threads. Rods made of brass pipe are too flexible when made of light tubing, and too heavy if made of strong tubing large enough in diameter to obviate flexibility.

Extension rods made of bamboo and lined with brass or aluminum pipe are light, strong and large enough in diameter to be handled conveniently without unduly tiring the operator. The base and top should be constructed like rod ends shown in Fig. 20, (24) or (25), for these thimbles prevent the accidental breaking of the rod at the juncture of the fitting and the lining pipe. Aluminum-lined rods of this type are practically as strong as the brass-lined ones, and they are much lighter in weight. Bamboo rods ten feet long are usually the most practical ones, although twelve-foot rods

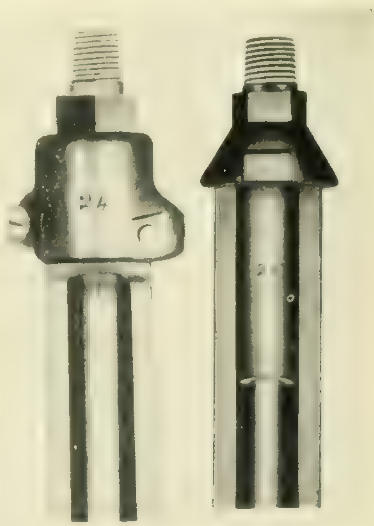


Fig. 20. (24) A section of an aluminum lined bamboo spray rod with a thimble extending over the outside of the bamboo casing. (25) A section of an aluminum lined bamboo spray rod with the long brass thimbles fitting closely inside the bamboo, and clamping it tightly endwise between the cup-shaped caps of the thimbles. The hexagonal and square sections permit the use of an ordinary wrench in tightening the connections.

are not too heavy nor too long for tall trees. The plain, thimbled bamboo rods, with wired ends, are seldom as durable as the kinds mentioned previously, as the bamboo is liable to split, and the rod ends are more readily broken off. The lining pipe and thimbles get loose and turn around in the bamboo support, and there is no satisfactory way to remedy the defect.

Angle Ells and Ys

Angle ells, like those shown in Fig. 21, but with base and top made hexagonal, are more convenient than either the round style (27), or the cast-iron angle, (28), which requires a pipe nipple in one end before a nozzle can be attached. These angle connections are used to change the direction of the spray by making the straight-based nozzle, used alone or on the plain Ys, almost face the perpendicular when the extension rod is held in the position for spraying. Angle Ys can be used in place of the angle ell of the plain Y. When more than one nozzle is used on a rod, straight nozzle should be used, as the angle-base nozzles have to be forced into position. When turned on tight, angle-base nozzles rarely stand in the correct position, while straight nozzles are always standing right when used on an angle Y, like that shown in (29); (30) has the nozzle branches made too divergent to be satisfactory, and cannot be used in practical work.

Nozzles

Spray nozzles are readily divided into four classes, when separated according to the different shapes of spray they form, but on account of the extreme variation or intermediate forms of spray which some nozzles give, it seems the better plan not to class them as hollow cone, solid cone, solid stream, and flat or fan-

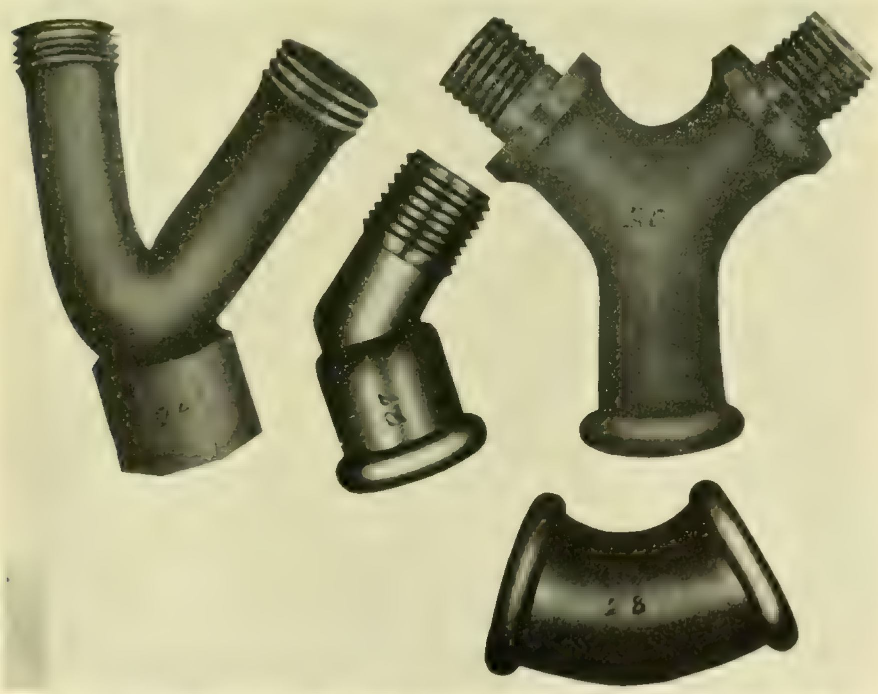


Fig. 21. (27) A one fourth inch brass angle L, with round base and top which requires a pipe wrench to hold it. A better type is one with a hexagonal section at the base and near the top which can be turned with an ordinary wrench. (28) A one fourth inch cast iron L, which requires a one fourth-inch pipe nipple before a nozzle can be attached. It is heavy and soon becomes corroded. (29) An angle Y, having branches diverging properly, and angled so that straight-based nozzles can be used. (30) A straight Y, with the nozzle branches too divergent for use in practical spraying.

Plate I. Test sheet showing the distribution of the spray by different makes of nozzles when placed on the nozzle testing machine. (1) Tiger. (2) Massospray. (3) Whirlpool. (4) Simplex. (5) Scientific. (6) Friend.

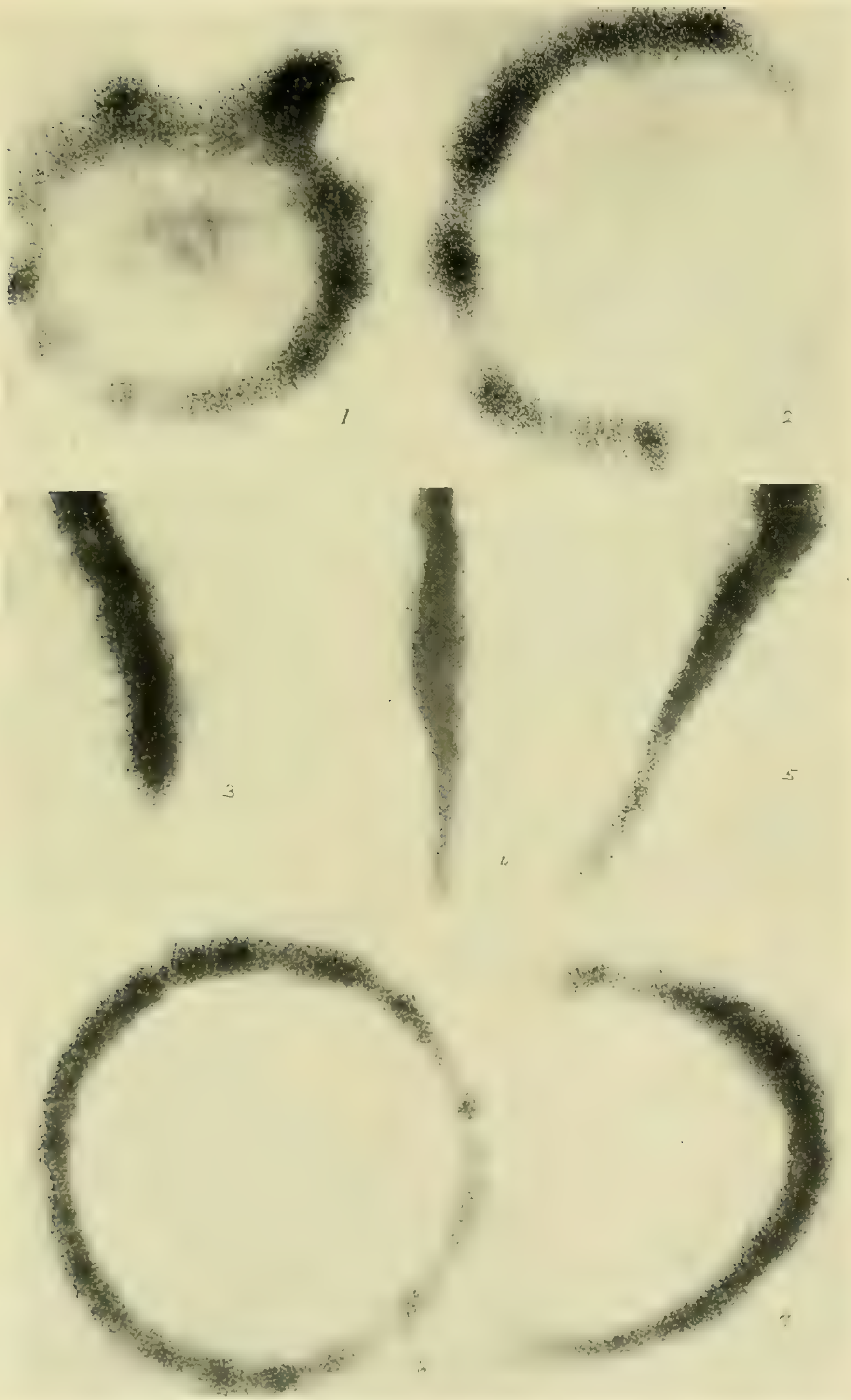


Plate II. Test sheet showing the distribution of the spray by different makes of nozzles when placed on the nozzle testing machine. (1) Morrill and Morleys' Vermorel. (2) Myers' Graduating Vermorel. (3) Clipper. (4) Myers' Bordeaux. (5) Blizzard. (6) Deming Vermorel (7) Demorel.

shaped types of spray nozzles. When divided into classes according to their construction, several fairly balanced groups are formed, which are known as Disc, 22, (31), Vermorel, (32) and (33), Modified Vermorel, (34) and (35), Self Cleaner, (36), Cap, Bordeaux, Cyclone, and Solid Stream nozzles. This classification follows the trend of names with which we are more familiar, and these give some idea regarding construction.

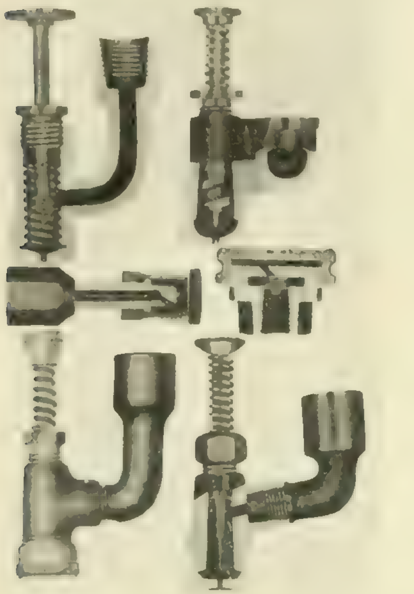


Fig 22 (31) Disc nozle. The simple straight based disc nozzle, showing the gradual change of direction of flow of the liquid and the large openings permissible with this type of nozzle. (32) A variable modified Vermorel nozzle. The head of the degorger, which is threaded and fits loosely in the threaded barrel, may be shifted in position to form a hollow cone spray when above the supply orifice, and a solid stream when below this opening. Packing under the nut prevents leakage around the degorger stem. (33) A modified Vermorel nozzle in which the whirl is imparted to the liquid in the whirl chamber by the spiral on the head of the degorger. A packing nut prevents leakage around the stem of the degorger. Note the number of changes of direction of flow, the abrupt angles and narrow orifices through which the liquid must pass in becoming a spray in all of the Vermorel nozles in comparison with the passage ways of the simple disc nozzle (34) A Vermorel nozzle. The outside appearance gives very little idea of the inner connection. Note the shape and projecting parts which catch over limbs. (35) A sectional view of a true Vermorel nozzle. The head of the nozzle may be set at an angle by turning it around on the threaded stem The liquid enters the whirl chamber through a hole at one side of the chamber which gives it the whirling motion around the needle of the degorger Packing under the nut prevents any leakage around the needle stems and the spring holds the needle back leaving the way to the hole in the cap unobstructed. (36) A sectional view of a Self Cleaner nozzle showing the narrow passage ways and the needle which cleans the hole in the cap when the head of the nozzle is pushed back.

Different nozzles are suited to different work, and, as their efficiency sometimes depends upon the amount of pressure used, care must be taken not to select a nozzle which will be unsuited to the machine with which it is to be used. Some nozzles are of very large capacity and should not be used with pumps whose capacity per minute is less than that of the nozzle. The Disc nozzles are larger in capacity than most of the Vermorel or Self Cleaner types; more compact, lighter in weight, less liable to clog, and do not have an projecting parts to catch over limbs and make trouble. Although Disc nozzles have been on the market for only a few years, they are rapidly superceding the older and more common types.

Most of the Vermorel and Self Cleaner nozzles are of small capacity, largely because the small orifices through which the liquid must pass, and the abrupt changes of direction which it must make, reduce its speed and nullify the effects which should be obtained if no hindrance was present. The Bordeaux nozzles, strongly advocated by many western orchardists, usually make a flat, fan-shaped spray which is coarse and much heavier in the center of the fan than at the edges. These are also of large capacity and can be adjusted to throw a solid stream of liquid.

Cap nozzles of small capacity are suitable for bucket pumps and small hand sprayers. They are often miniature types of Disc nozzles. Those of large capacity are preferable to the Vermorels. Solid Stream nozzles are best suited for spraying tall trees, and, because of their extremely large capacity, cannot be used with any of the smaller power machines. This observation applies especially to the Worthley nozzle, which has been developed for use in spraying for the control of the gypsy and brown-tail moths in Massachusetts.

A few types of nozzles which can hardly be given any definite place are included in the appended tables. These tables do not include all of the different kinds of spray nozzles sold in Ohio, but they include most of the important makes. The illustration shows the difference in the construction of some of the common nozzles, giving the defects and good points of the several kinds. It is a fault common to many of the hollow-cone spray nozzles to throw the bulk of the spray in one-half of the circle. In the case of Disc nozzles this may be prevented by increasing the number and the size of the openings in the directing disc, which is just below the whirl chamber. The angle of the spray may be changed by increasing the depth of the whirl chamber and the carrying power of the spray will be increased accordingly if the supply of spray liquid is adequate.

The depth of the whirl chamber and its proportion to the diameter have much to do with the width of the angle of the spray. The size, shape, angle, and number of supply holes in the directing dics also affect the spray obtained. The diameter of the hole in the cap or disc has much to do with the capacity of the nozzle.

The lack of care in machining the parts of the nozzle is often responsible for some of the discrepancies which are shown by the testing machine. When the hole in the cap has a burred edge or is not perfectly centered, one-half of the ring of spray is usually heavier than the other half. Burred edges on the holes of the directing disc are also the cause of unevenness in the ring of spray.

Nozzles having a wide-angle spray require that the operator keep the nozzle close to the object that is being sprayed, while those giving a narrow-angle spray usually require the operator to keep the nozzle some distance from the tree being sprayed in order to allow the spray to break up and cover the same area as a nozzle of the former class. Disc nozzles which throw an even, well distributed, broad ring of spray, with broken spray in the center of the circle, and which also have enough carrying power to the spray to permit the operator to hold the nozzle some distance from the tree, are especially desirable. The maximum of efficiency in the Disc nozzles is to be found in those which most nearly give a solid circle of spray.

Likewise, of the variable Disc types, the best patterns will be found in those which are capable of most nearly making a perfect ring of spray, though, of course, such types are also designed to grade their discharge from the perfect ring through the hollow cone to the long driving stream. A few of the true Vermorel nozzles give well distributed rings of spray. Most of the modified Vermorel nozzles throw the bulk of the spray in one-half of the circle, there being only one exception, and this one gives a narrow, even ring of spray. Only one nozzle of the Self Cleaner type gave an even ring of spray. The Cap nozzles were, with one exception, superior to most of the Vermorels, both in distribution of the spray and in capacity. The Cyclone nozzles are of little value, unless used in clusters. Many of the nozzles which do not distribute the spray evenly in the circle, can be used successfully in clusters. When thus massed together, good results are obtained, but they should not be used singly.

Squash

The squash is described as "the fleshy edible fruit of any one of the trailing annuals of the genus *Curcurbita* allied to the pumpkin." At least 60 varieties of winter and summer squashes are named by horticulturists, which include many forms, sizes, colors and adaptations for use. Some are summer varieties, others autumn, and still others may be kept for winter use and until the following early spring.

They may be grown either in field or garden, are rather hardy and vigorous growers. They should be planted in hills about six feet apart and in rows about the same distance. This method of planting gives room for the vines to form so as to produce an abundant crop. They

are pollinated by bees and other insects carrying the pollen from one flower to another, yet while they are closely related to the pumpkin, it is claimed that they will not hybridize with that species.

The following varieties are recommended by Samuel B. Green as being adapted to northern sections:

Summer Varieties

Cucurbita pepo

Summer Crookneck

A summer sort, generally with a crooked neck, that is highly esteemed.

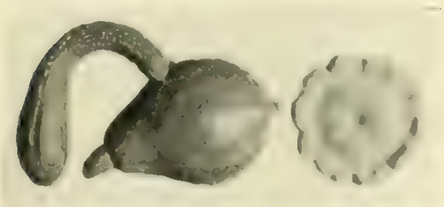


Fig. 1. Varieties of Summer Squashes.
Crookneck. Boston Marrow. Scalloped.

A form of this with a straight neck is also grown.

Bush Scalloped

Yellow and white varieties of this for summer use are much grown by market gardeners, differing from each other only in color of the skin. They are round-flat and have a scalloped edge.

Boston Marrow

Much grown for marketing and very highly esteemed for summer and fall use.

Orange Marrow

A form of the Boston Marrow.

Fall and Winter Varieties

Cucurbita maxima

*Hubbard

This is the best known and most largely grown of the winter varieties. It varies somewhat in form, is generally dark green in color and sometimes marked with red. When well grown it has a rough shell of flinty hardness and thick, heavy flesh that cooks dry. The quality varies much according to the quality of the land on which it is grown, sandy loam generally producing the best.

Marblehead

Marblehead is a variety that resembles the Hubbard in quality of flesh, and by many is considered superior. It differs from the Hubbard in form and color, is

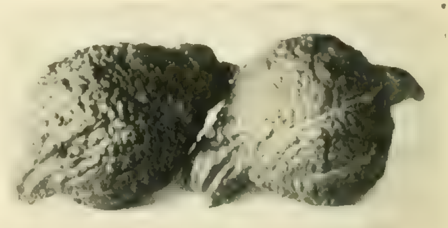


Fig. 2. Hubbard Squash.

ashy gray and the flesh is much thinner. It yields less in weight but generally produces more squashes per acre.

Essex Hybrid

Very fine grained, rich, sweet, and a good keeper; excellent for autumn and winter.

Bay State

A good variety.

Miscellaneous Varieties

Winter Crookneck

One of the hardiest, most reliable and best-keeping squashes, but in quality no better than some of the pumpkins. Very little in demand for marketing, but popular in some sections for home use.

Cocoanut, Perfect Gem and Chestnut are varieties producing a large number of small squashes of excellent quality and are very easily raised.

SQUASH DISEASES AND PESTS

Diseases and pests of squash are those common to the cucurbits, and where not specially treated here they will be found under *Cucumber*, *Cantaloup*, *Melon*, etc.

* In the Northwest the Pike's Peak is considered to be as good and perhaps a better variety in some localities than the Hubbard.

Pike's Peak is somewhat similar in shape to the Hubbard with a tendency to flattening at the ends a little more than the above variety. It is a much smoother variety. Its chief distinguishing feature is its color, which is a neutral blue gray. It is thick-fleshed and dry. —Ed.

Common Squash Bug

Anasa tristis De G.

Stink bug is a name often applied to this insect, as well as to several closely related forms, because of their disagreeable odor.

The squash bug is a sucking insect which feeds solely by extracting the plant juices. Fortunately, the bugs do not emerge from winter quarters until late in spring, and the early planted crops are usually well advanced when feeding commences.

Squash bugs are commonly present in gardens and fields from early June until late fall, and in addition to their destructive feeding habits they are charged with being distributing agents for the melon wilt disease, by transferring the wilt bacteria from one plant to another.

Squash and pumpkin are the favorite food plants, but other cucurbits are frequently attacked. Certain varieties of squash are injured more than others.

Description and Habits

Adult Bugs

Mature squash bugs measure about five-eighths of an inch in length. Their shape is shown in Fig. 1. The color is dirty brownish black above and yellowish beneath. The head bears two prominent antennae (feelers), projecting forward, and a slender jointed beak that lies flat against the body, between the legs, when not in use. These bugs are nocturnal in habit, hiding under leaves or other shelter during the day.

Eggs

These are quite large, about one-sixteenth inch long, oval in shape, bronzy-brown in color, and are laid at night in irregular rows on the underside of the leaves. Egg clusters contain from a few to 40 or more. They hatch in from eight to 13 days into small, awkward creatures, called nymphs.

Remedial Measures

Ordinary insecticides are of little value against squash bugs. Arsenical poisons are valueless and contact spray mixtures are effective only against the young soft-

Fig. 1. Squash Bugs. (a) Common Squash Bug; (b) Horned Squash Bug.

bodied nymphs. However, the bugs may be fought quite successfully by some one or more of the following methods:

Hand Picking

The first bugs appearing in spring should be collected by hand in order to prevent egg-laying. Later on, both adults and egg masses should be gathered and destroyed, or, if the eggs have hatched, the groups of young nymphs may be easily crushed. To facilitate catching the adult bugs, shingles, large cabbage leaves, or something of the kind, may be laid around the cucurbit plants, as many will take refuge under such shelter during the daytime. Eggs and nymphs will be found on the underside of the

growing leaves. Hand picking is profitable all summer if the bugs persist, but by thorough work most of the first generation may be destroyed, thus avoiding further injury.

Clean Culture

Burning or composting remnants of curcurbit plants, together with all rubbish about gardens and fields, both after the crop is gathered and during late fall or winter, will aid materially toward preventing the adult bugs hibernating successfully. This practice is equally valuable for checking the increase of many other injurious insects.

The horned squash bug yields to the same treatment.

North Carolina Bulletin 205.

Squash Lady Beetle

Epilachna borealis Fab.

The above common name is applied to a large species of lady beetle which may occur in small numbers on squash, gourds and other cucurbits. They are seldom numerous, but are mentioned because their feeding habits are so strikingly different from other lady beetles whose food consists chiefly of scale insects, plant lice, or other small insects. For this reason lady beetles are generally considered beneficial and should be encouraged to multiply.

The squash lady beetles, and their larvae also, are plant feeders, occasionally numerous enough to partially defoliate the plants on which they occur. Cucurbit growers should learn to recognize them in order to avoid making the mistake of attempting to destroy the really beneficial lady beetles, which resemble this plant-feeding species in general shape and appearance.

Description and Habits

Beetles

The beetles measure about one-third inch in length, have a small head and thorax and rather short legs. The whole body is slightly oval with a strongly arched back. The general cover is light yellow. The thorax bears four small black spots, while the wing covers when closed show 12 black spots of irregular size, two of which are divided by the inner margin of the wings, forming two large median dorsal spots. The ventral side of the body is yellow, marked with black. The legs are yellow.

The only other native lady beetle liable to be mistaken for this species has only nine black spots on the wing covers, while the body beneath is black, including the legs. It is also of a smaller size.

The Northern lady beetles hibernate during winter, come forth in spring and feed on the foliage of cucurbits, and at times on the rind of melons and squash.

Eggs

The eggs are yellow in color, elliptical in shape and are laid in clusters on the underside of the leaves.

Larvae and Pupae

The larvae are a little longer than the parent beetles, yellow in color, with each segment of the body bearing six prominent branched spines, of which the basal half is yellow and terminal half black. They always feed on the underside of the leaves. When grown they transform to the pupal stage, attached to a leaf, and after a week or 10 days change to adult beetles.

Remedial Treatment

Both larvae and beetles are slow and stupid in action, so that removing them by hand is readily accomplished, and generally nothing further is needed than an occasional hand picking. Poison sprays, applied while the plants are small, will kill many of the beetles.

Squash Vine Borer

Melittia satyriniformis Hbn.

As its name implies, this insect lives during the destructive period of its life as a borer in the main stem or leaf stalk, but prefers to feed in the woody tissue near the root. The damage is caused by the larvae, which are white, fleshy, grublike worms, changing eventually to moths somewhat resembling wasps.

Squash, simblins and pumpkins are the favorite food plants, although other cucurbits, like cucumbers and cantaloupes, are sometimes attacked.

Several borers may occur in a single squash plant and their presence remain unobserved until the whole plant suddenly withers and dies, seemingly in a single day. The reason for this sudden collapse is because the borers, feeding in the main stem, eventually girdle it completely, thereby cutting off the flow of sap from the roots to the branches, and the plant, thus suddenly deprived of food, rapidly withers under the hot July or August sun. If such plants are examined, quantities of powdered, yellowish excrement will be found around the stem, having been forced out of the feeding channels made by the borers. These dying plants usually contain several borers—a dozen or more is not an unusual number—for plants are often able to survive the presence of only three or four unless they happen to girdle the stem near the roots. Severe injury may usually be prevented by learning to recognize the first sign of borers, evidenced by the yellowish excrement around the stem, and removing them in the manner to be described later.

Distribution

Its distribution now extends from Canada southward to the Gulf states, and to the West at least as far as the Rocky mountains. It also occurs in Mexico, Central and South America, and is thought to be of tropical origin.

Description

Parent Moths

The adult or parent stage is a handsome moth belonging to a family known as clear-winged moths. The front pair of wings are opaque, olive-brown in color, with metallic-green reflections; the hind wings are clear and transparent, with black veins and a wide bronzy-green fringe of hairs. The hind pair of legs bear a heavy fringe of hairs, those on the outer edge orange or reddish, while the inner fringe is black. The abdomen is conspicuously orange or red, with black or bronze markings. Altogether, these moths present a striking appearance. (Fig. 1.) They are readily recognized as they fly about squash plants, depositing eggs during the day, and may be easily captured in a butterfly net, or knocked down with an evergreen brush or similar weapon.

Eggs

These are dull reddish-brown in color, oval, about one-twenty-fifth of an inch in length, and when magnified, show a surface composed of many five, six, or seven-sided areas. The eggs are glued to the plant and flattened on the attached side.

Larvae

Larvae or borers are robust, white, grublike worms (Fig. 1), with the body distinctly segmented. Average length is about one inch.

Cocoons and Pupae

When the borers are fully grown they desert their feeding burrows, tunnel an

Fig. 1. Squash Vine Borer. (1) Adult. (2) Larvae and pupae. (3) Empty pupae shell showing manner of escape.

inch or two into the soil, and there construct cocoons in which they transform to the pupal stage.

Life History and Generations

Squash vine borers pass the winter in the pupal stage in the soil. Parent moths, commencing to emerge during late April or early May, soon mate and lay eggs on all parts of the plants, but chiefly on the main stems. Eggs hatch in from 6 to 15 days, usually nearer the former, and larvae attain full growth in about one month.

The cocoons are formed in the soil an inch or two below the surface, near infested plants. The pupal stage lasts from two to three weeks, or all winter, depending on the generation it represents.

The entire life cycle covers nearly two months, allowing one week for eggs to hatch, four weeks for larval development and three weeks for the pupal stage.

The second generation occurs mainly during August and September. After this the food supply is largely exhausted.

Remedial Measures

Cultural Methods

Clean farming methods, such as the most successful farmers are accustomed to practice, involving the prompt removal and destruction of squash, cantaloup and other cucurbit crops when their yielding season is past, serve in a large measure to reduce the annual injury from squash vine borers, and also other insects.

These crops are generally worthless after July or August, particularly when borers are numerous; so that, by pulling and burning, or composting infested plants, hundreds of borers in the stems or fruit may be killed.

The compost heap furnishes, in the writers' opinion, a valuable method of disposing of remnants of garden or field crops, as it produces a manure that most soils require. As a means for destroying insects like squash vine borers, melon worms and others, the compost heap may prove as effective as fire if the infested material is packed down and covered with earth, or decomposed compost, in order that the heat generated in the pile may destroy the larvae and pupae or imprison the adults, which sometimes emerge from their cocoons a few days after the material is piled. Many moths may mature and escape from cucurbit plants which are gathered and dumped loosely in a pile. It is safest to burn this material and thus lose most of its fertilizing value, unless it is worked into compost as suggested. Diseased vines should always be burned.

Late fall and early winter plowing serves to bury over-wintering pupae so deep that the emerging moths cannot escape, or exposes the pupae so that some die from unfavorable weather conditions and others fall prey to birds and fowls. One objection often raised to fall plowing is that land should not remain bare all winter; but that condition may be avoided by sowing some cover crop like crimson clover, vetch, winter rye, or winter oats, which puts the land in better condition than it would be otherwise.

Deep spring plowing and rotation are valuable.

Remove borers during June by splitting the stems lengthwise.

Kill moths when seen flying around.

R. I. Smith,

North Carolina Experiment Station Bulletin 205.

Stink Bug. See *Squash Bug*, this section.

Squirrels. See *Rodent*.

Standard Barrel Act United States. See *Law*.

Storage. See various articles under *Marketing*.

Strawberry

The strawberry belongs to the botanical species *Fragaria chiolensis*. Perhaps no fruit is more adaptable to the different varieties of soil and climate than the strawberry. It is found growing in Florida and Alaska, two extremes of the United States, and while they will probably not prove a profitable commercial crop in Alaska without change of character so as to adapt them to that climate, C. C. Georgeson, in charge of the experiment stations there, thinks that by crossing with native seedlings, varieties may be produced that will at least be profit-

Nick Ohmer.
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ably grown for home use. They have been found growing wild in Europe, Asia, and America, under all conditions of climate and soil favorable for other forms of plant life.

The origin of the strawberry cannot be traced, but like many other valuable plants and fruits, was found growing wild in the countries where it has been domesticated. It attracted attention in Europe about 1712; but has not been in general cultivation more than about 50 years.

STRAWBERRY CULTURE

C. C. Vincent

The strawberry industry in the Northwest compares favorably with the apple industry in the adaptability of the plants to soil and climate and in the universality of demand. With a constantly increasing demand, and no apparent prospect of our markets being fully supplied, it is not surprising that many are turning their attention to the development of the strawberry.

The cause of such rapid advancement has not been due alone to the dissemination of information through our agricultural press, but to the increase of railroad facilities, the development of the refrigerator car and other means of transportation, which gives the strawberry a wide marketing range. A strawberry plantation will come into profitable bearing in about two years, while an apple orchard will require eight years.

Districts Defined

[For Puget Sound District, see article following this.—Ed.]

Conditions throughout the Northwest vary so greatly with the different localities in soil, humidity, elevation, etc., that a brief description of the principal districts where strawberries may be grown profitably is essential to begin with.

Northern Idaho and Northeastern Washington

This section comprises the northern part of Idaho and Northeastern Washington westward from the summit of the Bitter Root mountains to the Columbia valley or the point where it makes its westward turn. A portion of the southwest corner of this section would not be included.

The elevation varies from 1,000 to 4,000 feet, and the rainfall from 20 to 30 inches. The climate is rather mild in summer, and not severe in winter. The soils are of a glacial formation or lake-bed deposit, with some areas of volcanic origin in the southwest portion, which vary in color from a red to a dark brown loam. These soils are capable of retaining an ample supply of moisture, when intensive cultivation is practiced, thus eliminating

the necessity of irrigation except in the western portion. A large portion of this region has been covered with timber and recently logged over. The soil was found to contain more or less acid, and a liberal application of lime may be found beneficial.

The Palouse Country

This region includes Latah and a section of Kootenai county in Idaho, and Whitman and part of Spokane county in Washington. The climate is humid with an annual precipitation of 20 to 30 inches. The elevation varies from 1,000 to 3,000 feet. The contour of the country is rolling. The soil is of a basaltic formation, very fine in texture, and holds moisture remarkably well. The deep, moist friable soils characteristic of this region are admirably adapted to the growing of the strawberry. Frequent cultivation during early spring and summer will aid the strawberry growers in obtaining very satisfactory yields.

Lewiston and Clarkston Districts

This section comprises Nez Perce, parts of Idaho and Lewis counties in Idaho, and a portion of Asotin county in Washington. The lowest point in Idaho is in the Lewiston valley, having an elevation of 700 to 750 feet. To the south and east of the Clearwater, there is a gradual rise in elevation, reaching an altitude of 3,000 feet in some parts. The annual precipitation ranges from 12 to 20 inches. Certain parts of this country require irrigation, but at the present time this is not practiced to any great extent outside the vicinity of Lewiston and Clarkston.

The climate, being mild in summer and pleasant in winter, presents conditions especially favorable to the production of the strawberry. The soil is very easy to work, being of a loose friable nature, and described as a sandy volcanic ash of basaltic origin. It is quite rich in all the elements necessary for plant growth, the only deficiency being in nitrogen, which can be easily supplied by giving a liberal application of barnyard manure, or by the growing of leguminous crops.

Payette, Weiser and Malheur Valleys in Idaho and Along the Snake River in Oregon

These valleys comprise part of Canyon and Washington counties in Idaho and Malheur county in Oregon. The soil is a volcanic ash and varies from a light, sandy soil on the uplands to a heavy dark loam in the valleys. Under irrigation these soils are admirably adapted to the growing of the strawberry and at the present time many small acreage farms are being planted. It is not unusual for growers in this region to get from 200 to 300 crates per acre.

The annual precipitation ranges from 10 to 20 inches, thus the necessity for irrigation. The altitude is from 2,000 to 3,000 feet. Since the strawberry can be grown to perfection, this section offers many attractions to the strawberry enthusiast. The transportation facilities are such that the grower is enabled to ship his berries to distant markets without much difficulty. Excellent local markets are within easy reach of all.

Boise Valley

This valley cromprises a region in the south central part of Idaho. With the combination of soil, climate, and water that this region possesses, strawberries grow in profusion. The climate is very mild. The long summer days coupled with a long growing season make this section ideally adapted to the raising of strawberries.

The soil is very rich, being volcanic ash of a decomposed basaltic formation. Throughout the valley sandy, loamy soils abound. The elevation varies from two to three thousand feet. This region has an annual precipitation of 10 to 15 inches. Irrigation is depended upon to mature the crops grown in the valley.

Idaho Falls

The Idaho Falls region comprises Bingham and Fremont counties in Idaho. The industry in this locality offers many inducements and the grower has excellent local markets for the disposition of his fruit.

The soil is of a lava formation, being sandy in nature, loose and easy to work.

This region depends upon irrigation for the maturing of its crops, as the annual rainfall is only ten to fifteen inches. The elevation ranges from four to six thousand feet.

Twin Falls

The Twin Falls district, consisting of portions of Twin Falls and Lincoln counties in Idaho, is in the southern part of the state near the southern border. The horticultural interests are very highly developed in this section. The fruits, as well as small fruits, grow abundantly. The growers have demonstrated that strawberries can adapt themselves to all parts of this region.

The soils are of a lava formation and sandy in nature, which is characteristic of a large region in the southern part of Idaho. The elevation varies from 3,000 to 5,000 feet, and has an annual rainfall of 10 to 15 inches.

The Coast Region

This region, consisting of a strip along the Pacific coast in Oregon, 40 miles in width at the widest parts, comprises the counties of Clatsop, Tillamook, Lincoln, part of Lane and Douglas west of the Coast range, Coos, and Curry. The country is composed of rolling hills, mountains, slopes, small fertile valleys, and rich uplands. The annual rainfall varies from 55 inches to 132 inches. The soils in the valleys and lowlands are very deep and rich in humus, composed of alluvial deposits and silt. Upon the uplands the red clays and sandy loams predominate. The strawberry industry while still in infant stages of development, offers many attractions in various localities of this region.

The Willamette Valley

The Willamette valley, located in the north central part of Western Oregon, is the largest and most important valley in the state. It comprises the counties of Columbia, Washington, Multnomah, Yamhill, Clackamas, between the Coast and Cascade ranges. This section embraces a most fertile and productive area, with slightly variable conditions of climate and soil and other material advantages. The elevation ranges from 100 feet above sea level on the broad open prairies to 2,000 feet near the foothills. The average annual rainfall is from 40 to 50 inches. The soils being of alluvial deposit vary from a sandy to a clayey loam in the valleys to a reddish clay in the foothills. In many sections of the region the strawberry is one of the leading small fruits grown, and large quantities are grown annually to supply the local demand.

Umpqua Valley

The Umpqua valley is a rich and fertile region wholly within the county of Douglas, Oregon. This section is similar to many other large valleys in Oregon, for it contains many smaller valleys which extend back into the creek canyons. The soils of the valleys are alluvial in character, while on the foothills and mountain slopes they are of a reddish loam. The elevation ranges from 300 feet in the bottom to 4 000 feet in the uplands. The average maximum precipitation ranges from 20 to 40 inches. Irrigation is not necessary for the maturing of the crops. Strawberries grow exceptionally well in all parts of this valley.

The Rogue River Valley

In the most southerly portion of Western Oregon lies the Rogue River valley, which consists of Jackson and Josephine counties. The soils ranging in depth from 10 inches to several feet are of an alluvial disintegrated lava and granite formation. The black, gray, and red soils are all rich in the essential qualities necessary for the production of excellent strawberries. The altitude ranges from 1,000 to 3,000 feet. The annual rainfall is between 20 and 25 inches. Irrigation is practiced quite extensively in many parts of this valley. A large amount of the strawberries found in the larger cities comes from this rich and fertile valley.

The Dalles District

This district, which consists of Wasco, Hood River, Morrow, Sherman, Gilliam, and Wheeler counties, is east and north of the great plateau region. It is moun-

tainous in places but is generally rolling hills, high tablelands, and narrow valleys as a rule. The soils throughout this region are of basaltic origin, while in the valleys volcanic ash and silt are found; all are deep, rich, fertile, and lasting. The rainfall varies from 9 to 36 inches, so in places it is necessary to irrigate to mature crops. Owing to the abundance of sunshine, the strawberry grows to perfection, so is one of the leading crops in many of the highly developed valleys.

La Grande District

In Northeastern Oregon is located the La Grande district, which comprises the counties of Baker, Grant, Umatilla, Union and Wallowa. The soils of this territory are of volcanic origin and are rich, deep, and productive. The elevation ranges from 450 to 3,000 feet. Irrigation in many instances is depended upon to mature the crops. The long growing and early maturing season makes this region admirably adapted to the production of small fruits. The products are of fine quality and meet with ready sale upon the market.

Central Oregon Region

In this section the counties of Klamath, Lake, Crook and Harney are found. The great level plains and rolling uplands are characteristic of this region. The soils are composed of disintegrated lava, underlaid with porous lava and basalt. The average annual rainfall for Central Oregon is about 12 inches, and is not sufficient to mature crops without irrigation. While ideal conditions do not exist in this region for growing strawberries commercially, by selecting the hardier varieties enough can be grown to supply home consumption.

SOILS AND PREPARATION

Kind of Soil

The strawberry thrives on a wide range of soils. This plant can adapt itself to almost any type of soil found in the Northwest. In fact a soil that will produce good field crops is satisfactory for growing the strawberry. It seems to be the consensus of opinion among the growers throughout these different regions that the light, warm, sandy moist soils produce the best crops. "The soil which seems the best adapted for growing strawberries is a sandy loam. Heavier soils are good, but require more cultivation, as they bake hard, especially after rain or irrigation."*

Preparation

To meet with the best success the ground should be placed in excellent condition before the plants are set. Deep plowing is essential. The growers should endeavor to put the surface of the soil in a mellow condition. To accomplish this he will find the disc harrow and clod masher serve a useful purpose. The strawberry thrives best on a soil containing large amounts of plant food, hence if these elements are lacking they should be added. Successful strawberry growers give their land a good application of stable manure in the fall and plow early in the spring.

LOCATION

Site

The proper selection of a site is one of the important factors to be considered in successful strawberry culture. Neglect in this respect often results in failure. The following points are well worth considering in making a selection. Low lands, lower than the surrounding area, should be avoided as the cold air seeks these places making them more subject to frost than those slightly elevated. Air drainage is as important as soil drainage. When slightly elevated places are selected good air drainage is insured.

Slope

Considerable importance should be given to the matter of selecting a suitable slope for the berry plantation. A southern aspect is preferred when early berries are desired. An exposure to the south insures a warm soil, thus maturing and ripening berries in advance of any other slope. However, discretion should be used if there is danger of early spring frosts or excessive heat. In either case

* W. H. Garner, Preston, Idaho.

a northern or eastern exposure should be selected, as the ground is cooler, thus retarding the blooming period and giving more moisture.

Irrigation

Since irrigation is such an important factor in the procuring of large berries the location should be carefully considered. It is very essential that the ground be thoroughly pulverized and leveled before planting, as this is an important factor in irrigation. Level land is usually given the preference by most growers, but slightly elevated places can be utilized to good advantage by planting on contour lines. The irrigation furrows can be run in such a way as to prevent washing of the soil. Strawberry growers in the Hood River valley, Oregon, are meeting with remarkable success with this system. Steep grades should be avoided.

Transportation

Proximity to shipping stations, if berries are grown for distant markets, or the nearness to local markets if catering to the local trade are points to be considered in selecting a location for a berry plantation. Strawberries cannot stand rough treatment, and if hauled a few miles over a poor road usually reach their destination in poor condition. If the grower intends to go into the business on a commercial scale and expects to grow berries for distant markets it is well to locate where there are competing lines of transportation. This usually enables him to secure cheaper rates. A perishable product like the strawberry cannot be grown too far away from the place of consumption unless special means, such as ice refrigeration, has been secured to stay its ripening process.

SELECTION OF VARIETIES

What the Market Prefers

The selection of the proper varieties is an important question to the one contemplating the growing of this fruit. His success depends largely upon this, as many varieties are quite local in their requirements. The grower must also decide whether the berries are to be grown for market, home use, or for the cannery. The shipping quality of the fruit is of prime importance when growing berries for the market. Some varieties are fine shippers, though not of the best flavor and quality, but no trouble is experienced in disposing of them. In growing berries for this trade they should be firm, regular in form, possessed of pleasing color, and large. The well-selected berries always bring the best prices in the market. "My observations are that most people prefer a dark red berry and one that is red to the core, as it generally has the best flavor."‡

For Home Use

When growing berries for home consumption it is well to select those that will ripen their fruit in succession throughout the season. This will enable the farmer to be well supplied with delicious berries during the summer. Particular attention should also be given to the bearing qualities of the fruit when selecting for home use. Some varieties are prolific bearers, but are very poor shippers. The flavor, size, and color are also points that should be borne in mind when selecting varieties for the table.

For the Cannery

The canneries prefer a berry that is firm and red throughout. Those that are soft and fall to pieces after being put up are not desirable to grow for this trade. Varieties grown for the general market are very good for canning purposes.

Fig. 1. Brandywine.

‡ Mr. J. E. Butler, Lewiston, Idaho.

The following varieties are grown quite extensively throughout the different sections mentioned:

Northern Idaho and Northeastern Washington

Varieties Grown.—Pride of Michigan,* Parson's Beauty,* Sharpless,* Senator Dunlap,* Climax,* Cardinal,† William Belt,* Brandywine.*

Recommended varieties for commercial planting. — Parson's Beauty,* Clark's Seedling,* Senator Dunlap,* William Belt,* Glen Mary,* Brandywine.*

Palouse Country

Varieties Grown. — Sample,† Brandywine,* Gandy,* William Belt,* Senator Dunlap,* Clark's Seedling,* Rough Rider,* Marshall.*

Recommended varieties for commercial planting.—Gandy,* Clark's Seedling,* William Belt,* Senator Dunlap,* and Marshall.*

Lewiston and Clarkston District

Varieties Grown.—Warfield,† World's Wonder,* Crescent,† Glen Mary,* Magoon,* Tennessee Prolific,* Dewey,* Wilson.*

Recommended varieties for commercial planting.—World's Wonder,* Warfield,† Clark's Seedling,* Glen Mary,* and William Belt.*

Payette, Weiser and Malheur Valleys

Varieties Grown.—Senator Dunlap,* Warfield,† Glen Mary,* Aroma,* Parker Earle,* William Belt,* and Jumbo.*

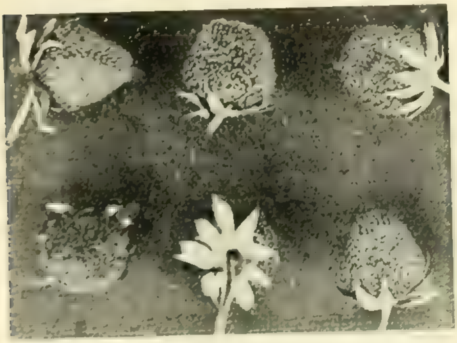


Fig. 2. Parson's Beauty.

*Bi sexual
† Pistillate.

Recommended varieties for commercial planting.—Senator Dunlap,* Warfield,† Glen Mary,* and William Belt.*

Boise Valley

Varieties Grown.—Jumbo,* Climax,* Magoon,* Haverland,† New York,* William Belt,* Dorman,* Pride of Michigan,* Parson's Beauty,* Parker Earle,* Sample,† Jessie,* Glen Mary,* Klondike,* Miller,* and Warfield.†

Recommended varieties for commercial planting.—Climax,* Magoon,* Dorman,* Parson's Beauty,* Pride of Michigan,* New York,* William Belt,* and Glen Mary.*

5 6 7 8

Fig. 3. William Belt.

Idaho Falls

Varieties Grown.—Jumbo,* Wilson, Sample,† Stevens' Late,* Gandy.*

Recommended varieties for commercial planting.—Jumbo,* Senator Dunlap,* and Gandy.*

Twin Falls

Varieties Grown.—Marshall,* Senator Dunlap,* Warfield,† Gandy,* Aroma,* Glen Mary,* William Belt,* and Jacunda.*

Recommended varieties for commercial planting.—William Belt,* Glen Mary,* Marshall,* and Jacunda.*

*Bi sexual.
†Pistillate.

Fig. 4. Rough Rider.

Willamette Valley

Varieties Grown.—Gold Dollar,* Sixteen to One,* Magoon,* Clark's Seedling,* Autumn Bell,† Marshall,* Wilson, Dorman.*

Umpqua Valley

Varieties Grown.—Gold Dollar,* Everbearing, Clark's Seedling,* Magoon,* Sixteen to One.*

Rogue River Valley

Varieties Grown.—Gandy,* Glen Mary,* Parker Earle,* Aroma,* Jumbo.*

The Coast Region

Varieties Grown.—August Luther,* Glen Mary,* Magoon,* William Belt,*

See also article on *Strawberry Culture on Puget Sound*, at the end of this article.

The Dalles District

Varieties Grown.—Clark's Seedling.*

La Grande District

Varieties Grown.—

Central Oregon Region

Suggested varieties for trial.—Warfield,† Bederwood,* Clark's Seedling,* Parson's Beauty.*

A List of Varieties that Will Stand Shipment

To ship berries successfully to distant markets, it is essential to grow varieties possessing great firmness and keeping qualities that will stand transportation. The following varieties, owing to the firmness of the fruit, would be excellent for shipping to distant markets:

* Bi sexual
† Pistillate.

Warfield,† Brandywine,* Crescent,† Parson's Beauty,* Klondike,* William Belt,* Clark's Seedling,* Jacunda,* Glen Mary,* and Aroma.*

POLLINATION

Bi-Sexual and Pistillate Flowers. In selecting varieties for the plantation it is well for the grower to become familiar with the sex of the plant. Strawberry plants fall into two classes when the flower characters are compared: (1) bisexual; (2) pistillate. The plants known as bi-sexual, or perfect, have the power of producing both stamens and pistils. The pistillate plants produce pistils only. Some growers have been unsuccessful in growing those varieties that fall under the pistillate class because they did not plant them in close proximity with perfect kinds to insure fertilization. Such varieties as Mark Hanna, Haverland, Buback, President, Sample, etc., should not be planted alone.

Alternating Varieties in Rows. To insure complete fertilization the varieties that fall in these two classes should be alternated in the rows. There is some diversity of opinion among the growers as to the proportion of perfect and imperfect plants that should be planted. Excellent results have been obtained when one row of the pistillate is alternated with two, three or four rows of the bisexual. Some authorities in discussing the subject recommend planting two rows of the pollenizer with two of the pistillate. Varieties that bear blossoms about the same time should be selected for this purpose.

PLANTING

Selection of Plants. Care should be exercised in the selection of the plants for the new plantation. If bought from a strawberry dealer the grower should insist upon having the best. Only plants that have developed strong crowns and healthy root systems are capable of producing large crops. Hardly two plants out of thirty develop large thrifty roots, hence the necessity of careful selection. Only plants formed by runners should be

* Bi sexual.
† Pistillate.

used for this purpose. The selection of plants from the old bed should be avoided as much as possible, as continued fruiting saps the vitality, thus preventing, to a marked degree, the development of strong runners.

Treatment Before Planting. When plants have been ordered through a strawberry firm they usually arrive in small bundles packed in damp moss. Plants are very seldom set out on their arrival, so in order to prevent unnecessary loss by moulding or drought, the bundles should be opened and "heeled in" immediately. In case the plants have become abnormally dry, immerse them in water up to their crowns for a few minutes and then heel them in. The heeling in process is a very simple one. All that is necessary is to dig a trench deep enough to cover the roots of the strawberry and lay in the plants close together in a single row with roots spread out. The soil should be pressed firmly around them leaving only the crowns and leaves exposed. This will prevent drying out. When the time arrives for the transferring of the plants to the field it is very essential that they be protected so as not to subject the roots to the action of the wind. Drying out of roots is very detrimental to the life of the plant. As a means of precaution many growers practice dipping the roots in water and placing the plants in small bundles, then wrapping with a damp cloth.

Pruning the Plant. The plants should never be placed in the field just the way they have been received from the nurseryman. Experience has taught us that it is a good plan to correctly prune the plant before setting, as it will respond more quickly in the spring and make a more vigorous growth than one carelessly pruned or left unpruned. In preparing the plants for setting all the diseased and dead leaves and all large ones, except one or two of the thriftiest, should be removed. A removal of the leaves prevents excessive transpiration. To establish equilibrium between top and roots it is a good practice to remove about one-third of the root. Fig. 5,

Fig. 5. Pruned and Unpruned Plants.

Nos. 1 and 2, represents a pruned and unpruned plant. As shown in No. 2 all the leaves except one have been removed and the roots shortened back to the line.

Time of Planting. Fall and spring planting are both practised in the Northwest. However, fall planting is not advocated in many sections, although permissible in regions having ample rains. Springtime has the preference by the majority of the growers, as at this time the soil is moist, warm, and in better condition to be worked. When set carefully the plants will respond with a more rapid growth, thus producing the following season a large crop of berries for the grower. In discussing this subject Mr. Garner says: "My experience has proved that spring planting is the most satisfactory, for the reason that a plant set in the fall does not have time to produce a large crown system, which is essential to a large crop of berries."

Setting the Plant. The rows should be evenly spaced and marked out. If possible it is a good practice to have the rows run north and south, as the berries will color up much better. Many devices are used to mark out the rows. A simple one can be made by nailing some two by four-inch pieces together at the proper distance and attaching a handle or tongue. A shovel-toothed cultivator can also be used for this purpose. After marking, the grower is ready to set his plants, and this may be done by the use of a trowel, dibble, or spade. The hole is opened and the plant placed in at the proper depth, with the roots spread apart

like a fan, as shown in the illustration (Fig. 6). The soil should be pressed firmly against the roots of the plant. Fig. 6, Nos. 1, 2, 3, 4 show the proper and improper methods of setting. No. 1 represents the proper way of setting the

Fig. 6. Showing Proper and Improper Method of Setting.

plant, as the roots are well spread out and the crown placed just at the surface of the soil. No. 2 represents too shallow planting. In this case the crown is exposed much more than is necessary and the result will be more or less drying out. No. 3 shows the opposite extreme. The crown of the plant is set too deep and there is danger of the bud not pushing itself through the soil. No. 4 also shows careless planting, as the roots are bunched entirely too much. Many plants are lost annually by careless planting.

Systems of Planting

The Hill System. This system consists of growing the single plants in rows. No runners are allowed to form, and in this way the full strength of development is thrown into the plant. This causes the plant to stool out and develop additional crowns, which tend to produce fruit stems. If planted on the square three feet apart, the grower is enabled to work the soil both ways, thus eliminating hand cultivation. As some growers prefer to cultivate only one way, the rows should be two and a half to three feet apart and the plants from 12 to 18 inches apart in the row. Larger berries are grown by this system than the others. The following illustration shows this method of planting.

The Single Hedge Row. In this system enough runner plants are allowed to grow and form a continuous row. The usual method followed is to allow each mother plant to set two runners as shown in the illustration. The first runners developed are turned into the row and held in

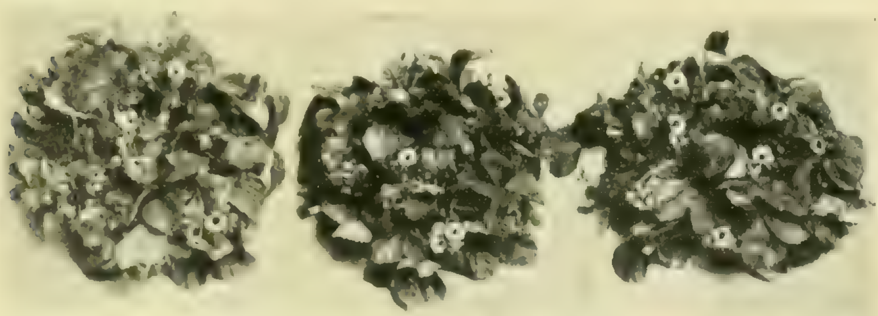


Fig. 7. Hill System.

Fig. 8. Single Hedge Row.

Fig. 9. Double Hedge Row.

place so as to encourage root growth. All other runners are clipped off. The rows should be two or three feet apart and the plants from 20 to 30 inches apart.

The Double-Hedge Row. By this system the mother plant is allowed to develop four to six runners. On four sides of the plant one runner each is allowed to set a plant. The following illustration shows this system very nicely. Superfluous runners should be removed. Many growers prefer this system, as the plants are distributed more uniformly over the ground. This eliminates crowding and permits plenty of sunlight and air, thus insuring a large crop of large, well-formed berries. The rows should be about three feet apart and the plants thirty inches in the row.

The Matted Row. The matted row system also has its advocates throughout the Northwest. Less labor is involved and the quantity of the fruit greater. It is a system that is becoming quite popular in sections where berries are grown for the cannery. All runners are allowed to develop. The cultivator is run in only one direction, and this enables the grower to narrow the rows as he sees fit. The proper distance apart is from three to three and one-half feet between the rows, and from 20 to 30 inches between plants. The following illustration shows the matted row system.

Plants Required per Acre. The following table will aid the grower in determining the number of plants required to set per acre:

PLANTS PER ACRE.

Distance.	No. Plants
1x1 foot	43,560
1x2 feet	21,780
1x3 feet	14,520
1¼x1½ feet	23,232

Fig. 10. Matted Row.

PLANTS PER ACRE.—(Continued)

Distance.	No. Plants
1¼x2 feet	17,424
1¼x3 feet	11,616
1½x1½ feet	19,360
1½x2 feet	14,520
1½x2½ feet	11,616
1½x3 feet	9,680
1 2/3x1 2/3 feet	15,681
1 2/3x2 feet	13,168
1 2/3x3 feet	8,712
2x1½ feet	14,520
2x2 feet	10,890
2x2½ feet	8,712
2x3 feet	7,260
2¼x2¼ feet	8,604
2¼x2½ feet	7,744
2¼x3 feet	6,453
2½x2½ feet	6,969
2½x3 feet	5,808
3x1½ feet	9,680
3x3 feet	4,840

TREATMENT OF PLANTATION IN IRRIGATED REGIONS

The Young Plants. While the strawberry is a plant that requires a great deal of water, the tendency is to irrigate entirely too much. The practice of allowing the water to run day and night should not be tolerated, since in this way many of the elements necessary for plant growth are washed out of the soil and other injuries result. The first summer after the plants are set they should be irrigated as little as possible. When the ground shows signs of drying out the first application should be made. The number of applications, however, should be governed largely by the moisture requirements of the different soil types. A few copious waterings, followed by frequent stirring of the soil to conserve moisture, is better than many shallow irrigations. Intensive cultivation should be practiced after every application.

The Bearing Plants. For early berries the water should be kept off just as long as possible in the spring. An application of cold water tends to chill the ground, thus retarding to a certain extent the ripening of the berries. Cultivation should continue until the plants begin to throw out blossoms, then it should cease. During the fruiting season frequent irrigations are advised. "For bearing plants I irrigate as soon as the ground begins to get dry, and after they begin to ripen I water two or three times a week, as it takes water to make big berries."

The method of applying the water varies in different sections. The majority of the growers of the Northwest do not advocate flooding. The most satisfactory way is to lead the water close to the rows in small rills. Better results are obtained by running a larger amount for a less time. While on the other hand, the coarse open soil should receive copious waterings of shorter duration. During the heat of the summer water has a cooling effect on the soil. Fall irrigation is practiced in some sections where there is a possibility of a dry winter.

TREATMENT OF PLANTATION IN NON-IRRIGATED REGIONS

The Young Plants. Just as soon as the young plants are set out in the spring cultivation should begin. This should be continued whenever needed up to the first of September, as it is very essential that strong healthy plants be developed the first year. Plants that are neglected during the first season seldom amount to much. It is highly essential that the soil be kept mellow and a dust mulch preserved in order to conserve the moisture. One of the best implements for this work is a wheel hoe or Planet Junior. This should be run over the plantation every ten days or two weeks or following every hard rain, as this keeps the soils loose, friable, and prevents a crust forming. The weeds should never be allowed to get a start in the plantation as they rob the plants more or less of the elements necessary for plant growth. However, if the grower begins operations just as soon as he is able to work the soil in the spring little trouble will be experienced.

There appears to be some difference of opinion regarding the summer treatment of young plants. Some growers say to let the plants bear the first season, but the majority are discouraging this method. For the perfect development of the plant no buds or blossoms should be allowed to develop the first season, as the plant thus has a better chance of building up a good strong crown and root system. Just as soon as a bud appears it should be

pinched off. If this method is adhered to large crops will be the result.

The Bearing Plants. To meet with the best success, bearing plants should receive as good care as the young plantation. With the fruiting plant intensive cultivation is essential to mature a large crop of berries. Frequent stirring of the soil aids in conserving moisture, and prevents it from drying out. No time should be lost in performing this operation. Just as soon as the ground is tillable in the spring the narrow-tooth cultivator should be started, and if the season is dry run continuously. A few rules to remember in cultivating the bearing plants are: (1) that the strawberry is a shallow rooted plant, hence the cultivations should be shallow so as not to disturb the fibrous roots; (2) a dust mulch should be obtained as this prevents undue evaporation; (3) grass and weeds seriously check the growth of the plants by robbing them of nourishment, thus they should never be allowed to get a start. Thorough clean cultivation is the secret of success in strawberry culture.

HARVESTING

When to Pick. The strawberry is a fruit that requires a great deal of care in handling. The patch should be gone over every other day—every day if necessary—to insure fancy fruit. For long shipment, the berries should be picked while still firm, and colored over with red on the upper side, blending into a light pink on the under. In discussing the subject of picking Mr. J. E. Butler says: "The only way to tell when berries are ready to pick, is by experience, picking them greener for shipping than for the home market. I prefer picking them a little green for all purposes, as they will ripen; while if picked ripe, hauled a few miles and set around the store awhile, the customer gets mainly juice."

The berries should never be picked if the vines are wet, as moisture invites fungi, and when placed on the market are uninviting and sell at a disadvantage. If allowed to stand in the sun for any length of time, a premature breaking down is the result.

Experts always pick berries by the stem, breaking them off a fourth to one half inch above the fruit. If the berries are seized by the fingers they soon become mussy and worthless and not fit for the local market. The grower should supply his pickers with small carriers, which hold from four to six boxes. The packing house or packing shed should be located in close proximity to the berry patch.

Method of Packing. Berries that bring the highest prices in the market are those which are packed neatly and carefully. The successful grower never allows overripe, ill-shaped, or small berries to find their way into the box. In order to establish a reputation it behooves him to put up a first-class pack. He should never allow a crate of berries to leave his packing house without first stamping on it his name and address. The packing of strawberries is not a complicated affair. The berries are brought to the packing shed, where they are emptied on small trays 3x3 or 3x4 feet in size and all imperfect or defective specimens removed. They are now sorted into their respective sizes and placed in boxes, the top layer being arranged evenly and attractively. These layers may be arranged in tiers 4x4, 4x5, or 5x5, according to the size. Berries under five tier should never be packed. When the solid pack is used the berries should come even with the top, for if too high they will be crushed by the cover and if too low will jostle about causing more or less bruising. One packer can put up from 12 to 20 crates of 24 quarts each per day and can keep three pickers busy. For direction on packing, see *Suggestions for Handling.*

Crates Used. At the present time one finds many styles of boxes and crates on the market. These vary in size and shape. The Boise market prefers the single deck, 15 tin-tip cups to the crate, while the 24-quart and 24-pint crate finds considerable favor in the Lewiston mar-

ket. There is, however, a splendid opportunity for the strawberry grower to build up an extra-fancy trade by marketing his fruit in specially constructed containers. These may be after his own origination or he may find something suitable which is handled by some strawberry firm.

It should be remembered that all markets prefer clean, neat boxes and crates, hence the necessity for cleanliness in the berry patch and packing house.

Marketing the Fruit. The marketing of the fruit in many cases is more of a business proposition than the growing. If the grower has access to a local association no difficulty will be experienced, but if not, arrangements should be made for their disposal before the harvest begins. As a general rule in many sections of the state the fruit is sold in the local markets. In transferring the fruit from the berry patch to the city, the grower should take every precaution to insure his berries against the heat and dust. Good spring wagons covered with a tarpaulin may be used to good advantage. When the output is less than a carload, and the grower wishes to ship a short distance, the pony express may be used successfully. The contrivance is partitioned off so that the ice can be placed at the top and the berries at the bottom. Berries placed in portable refrigerators arrive on the market in first-class condition. They may also be shipped short distances by fast express. When strawberries are shipped in car lots the grower should understand the methods of loading the car to insure his fruit arriving in prime condition in the market. Enough space should be left between each tier to insure perfect circulation of air. About five rows are made across the end of the car. Small laths are placed between the crates and nailed firmly so as to prevent them from jostling around. The center of the car is never filled, as this space is utilized by braces which hold the crates firmly in place and prevent them from moving lengthwise. Only refrigerator cars that have been previously cooled should be used in shipping berries. When these precautions have been observed good berries will carry six to seven days in prime condition. An ordinary car will hold from 600 to 700 crates.

Yields. Many elements, such as the care of the plantation, location, varieties grown, prices received, etc., determine largely the profits derived per acre. An average crop in Hood River, Oregon, is estimated at 150 crates per acre. The yield per acre in Idaho varies from 100 to 300 crates. The prices also fluctuate more or less according to the scarcity of the fruit.

Treatment of Plants After Fruiting. After the berries have been harvested the plantation should receive special attention. The old leaves should be removed, the ground stirred, and the weeds destroyed. There is no better way of doing this than by following the advice of Mr. D. M. Ragon, of Meridian, one of the most progressive growers in the Boise valley. He says in part: "After the berries are harvested mow the vines close to the ground. On drying rake the tops to the middle of the row and burn, then irrigate. When dry enough cultivate thoroughly between the rows and with the hoe draw the dirt evenly over the crowns being sure that it is well pulverized to the depth of one-half inch. Continue to irrigate the ground well the rest of the season, cultivating enough to down the weeds." The practice of covering the crowns assists the old plants in growing a new root system. Some growers have by care and attention secured two crops of berries during the season.

DURATION OF PLANTATION

Just how often the strawberry plantation should be renewed seems to be a disputed question in many sections. Lack of sufficient knowledge on this subject has caused many growers to give up in despair and pronounce strawberry growing an unprofitable industry. Mr. A. K. Bowden of Sand Point comments as follows on the subject: "The people have not yet learned that the strawberry must be renewed and cannot go on bearing

forever like the apple or other fruits, and for this reason many have become discouraged the third or fourth year, plowed them under and given them up." It is the practice in some sections for the growers to renew their beds every year, when the plants have been set in the fall. They claim where insect pests and fungous diseases are prevalent it is cheaper to plant new beds than to put the old plantation in shape again. The plants produce the largest berries the first year. Most all growers agree that two years is as long as a plantation may be run with profit. After the second year the fruitfulness and vigor of the plants greatly diminish. The practice of allowing the beds to produce crops the third and fourth year is followed by some, but the results obtained are as a general rule far from satisfactory. Commercial growers are agreed that larger yields and larger berries are obtained from younger plantations, thus the practice of renewing their beds every two years. To meet with success in the strawberry business the growers should plan to have a new bed coming on every year.

Keeping up the Strain. How can I improve my strawberries? is a live question with all progressive growers. One means of accomplishing this is by observing the following points: The new beds should be set with the best plants obtainable. Vigorous, healthy, productive plants only, should be used for this purpose. The grower should study his individual plants, as they are very peculiar in their habits, some possessing the power of growing an abundance of fruit, while others grow leaves. Those capable of producing a large number of berries should be marked in some way, and runner plants selected from them. From good, strong one-year-old plants the best selections can be made. The following illustration shows a desirable plant for propagating purposes. Continued selection for a number of years will enable the grower to improve his strain materially.

Pedigree of Plants. In case the grower has not the time or inclination to select his own plants, they may be secured through several reliable firms. The R. M. Kellogg Company, of Three Rivers, Michigan, is making a practice of sending out nothing but pedigree plants. Much has been said lately regarding the merit of these so-called plants. Their method of obtaining them is a matter of selection. Undesirable characters are eliminated as fast as time will permit. Thus by their process of long-continued selection, they have made rapid strides along the lines of improvement. There is no reason why commercial growers could not accomplish the same thing by a little forethought and perseverance.

SUGGESTIONS ON HANDLING STRAWBERRIES

The following are the rules for picking, packing, and hauling of strawberries issued recently by the Hood River Fruit Growers Union in Oregon:

Picking

1. Berries must not be picked while there is moisture on the vines.

2. Berries must be pink all over or three-fourths red.

3. Berries should be picked riper in cool weather than in warm.

4. Pickers must not be allowed to hold several berries in their hands at the same time.

5. Filled carriers must not be allowed to stand in the sun.

6. Berries must be picked with stem a quarter of an inch long; not longer or shorter.

*Packing

1. No culls in the boxes. Put nothing but fair-sized berries, none under five-tier.

2. After filling box about half full place the rest stems down, so as to be able to place the top layer all nice and level, stems down.

3. Fill boxes solid, leaving no vacant spaces, especially at corners, or they will be short weight, settle, spoil your pack and bring less money.

* The grade and pack rules of the Yakima Valley Fruit Growers' Association may be found at the end of this article.

4. Fill box so that top of layer will come three-eighths of an inch above the top of the box.

5. Allow no berries to project over side of box; if you do the berries will be crushed, the pack spoiled, and the box stained.

6. Packers must be required to sort out all green, over-ripe, misshapen and under five-tier berries.

7. Use clean crates and keep them from being soiled.

8. After crates are nailed, place them in a cool place in the packing house.

Hauling

1. Haul in spring wagon and use wagon cover to keep out dust.

2. Growers are requested to send in a load as soon as ready.

3. Do not wait until you are through with your pack for the day. If everybody waits until 6 p. m. the shipping association will not be able to load the day's pack.

DESCRIPTION OF VARIETIES

The following varieties have been grown on the testing plats at the Idaho Experiment Station during the past three years. In the notes upon the varieties, points that are of value or of interest to the grower have been discussed. Detailed descriptions of plant and fruit accompany each variety. Typical specimens of the several varieties were selected and photographed, and all uniformly reduced:

Variety.—Brandywine (bi-sexual). Originated by E. T. Ingram, of Pennsylvania.

Plants.—Plants of low-growing habit, vigorous, thrifty, and forming a medium number of runners. They are of medium size and comparatively free from disease. Foliage of a dark green color, medium size, with many leaves to the plant. Leaves rather thick, leathery, hairy, and of a fairly fine texture. The petioles are short and stout.

Fruit.—Berries of medium size, conical and wedge shape, irregular apex, deep crimson, with yellowish crimson seeds that are somewhat conspicuous. The fruit is firm, but rather soft at the core. Flesh varies from pink to scarlet, sub-acid, fair to good in quality. Fruit stems medium length, calyx large. Season, early to medium. First fruit ripe June 11.

Remarks.—The Brandywine is very productive and is a profitable variety to grow commercially. Good for canning purposes. A variety that continues in bearing for some time.

Variety.—Clark's Seedling (bi-sexual). The plants are small to medium, vigorous, healthy, very compact, and slightly subject to disease. The foliage is dark green, medium large, rather coarse to smooth. Leaf stems rather long, inclined to slender. Calyx large.

Fruit.—Medium, roundish to slightly conical, blunt, very attractive, color crimson. Flesh red to the core, very firm, well flavored and of good quality. Fruit stems long and slender. Season early to medium. First ripe fruit June 11.

Remarks.—A variety that is a good shipper, excellent for canning and very productive; can be grown successfully in many sections of the Northwest.

Variety.—Parson's Beauty (bi-sexual).

Plants.—An upright growing plant, vigorous, large, but not entirely free from disease. The plants send out many long runners. Foliage dense. The leaves are fine in texture, smooth, many to a plant, large, quite thin and dark green in color. Petioles rather long and slender.

Fruit.—Berries above medium to large, light crimson, with prominent greenish seeds extending out conspicuously. The shape is conical and wedge, often flattened, to fairly acute at the apex. The flesh varies from scarlet to salmon pink, firm but rather soft at the center, juicy, slightly acid, quality fair to good. Calyx bushy and large. Fruit stems long and slender. Season, early to medium. First ripe fruit June 11.

Remarks.—A variety that is very productive and is grown commercially in certain sections of the Northwest.

Variety.—Rough Rider (bi-sexual). Originated by Charles Learned, of New York.

Plants.—An upright growing plant, small to medium, thrifty and fairly free

from disease. Plants produce but very few runners. Leaves many, medium in size, dark green, with spreading habit. Inclined to be hairy. Leaf stem slender and medium in length.

Fruit.—Fruit medium, light crimson, elongated, conical, inclined to wedge. The flesh is uniformly scarlet throughout, firm texture and hard at the core. A variety that is juicy, rich, sweet and pleasant and of good quality. Peduncle medium slender to stout. Calyx medium to large. Season, early to medium. First ripe fruit June 11.

Remarks.—One of the best varieties grown on the Idaho Experiment Station grounds. Very productive. Desirable for home or for market.

Variety. — William Belt (bi-sexual). Originated by William Belt, of Ohio.

Plants.—The plants are low and spreading, large, vigorous, but inclined to be susceptible to disease. Leaf stalk long and slender. The leaves are large, light green, smooth and of fine texture. Foliage of medium thickness.

Fruit.—Berries large, fairly uniform, conical, inclined to coxcomb, apex acute to blunt. Calyx large, peduncle above medium length and slender. The berries are uniformly covered with scarlet; attractive; flesh scarlet to pink to the center. Moderately firm, mild, sweet, rich, pleasant flavor and of excellent quality. Season early to medium.

Remarks.—These plants produce large berries of excellent flavor. A desirable variety for commercial planting.

In order to assist the grower in distinguishing between early and late varieties the writer has placed them according to their fruiting season into the following groups:

Early to Medium Varieties

Senator Dunlap	Midnight
Parson's Beauty	Rough Rider
William Belt	Parker Earle
Miller	Brandywine
Clark's Seedling	Aroma

Late Varieties

Sample	President
Marshall	Mark Hanna
Oregon Iron Clad	Haverland
Gandy	Buback

Variety for Columbia River District

We advise that all, in this part of the country, confine their varieties to the Clark's Seedling. While this is not the heaviest yielder, experience has demonstrated, year by year, that there is more profit to growers here in this variety than in any other. It is by all odds the best shipper and the most popular in the market. There are other varieties slightly earlier, but do not stand shipping. The later varieties do well, but come into competition with berries from other districts, and even though the yield is larger, the net proceeds are less.

E. M. Sly,
Kennewick, Wash.

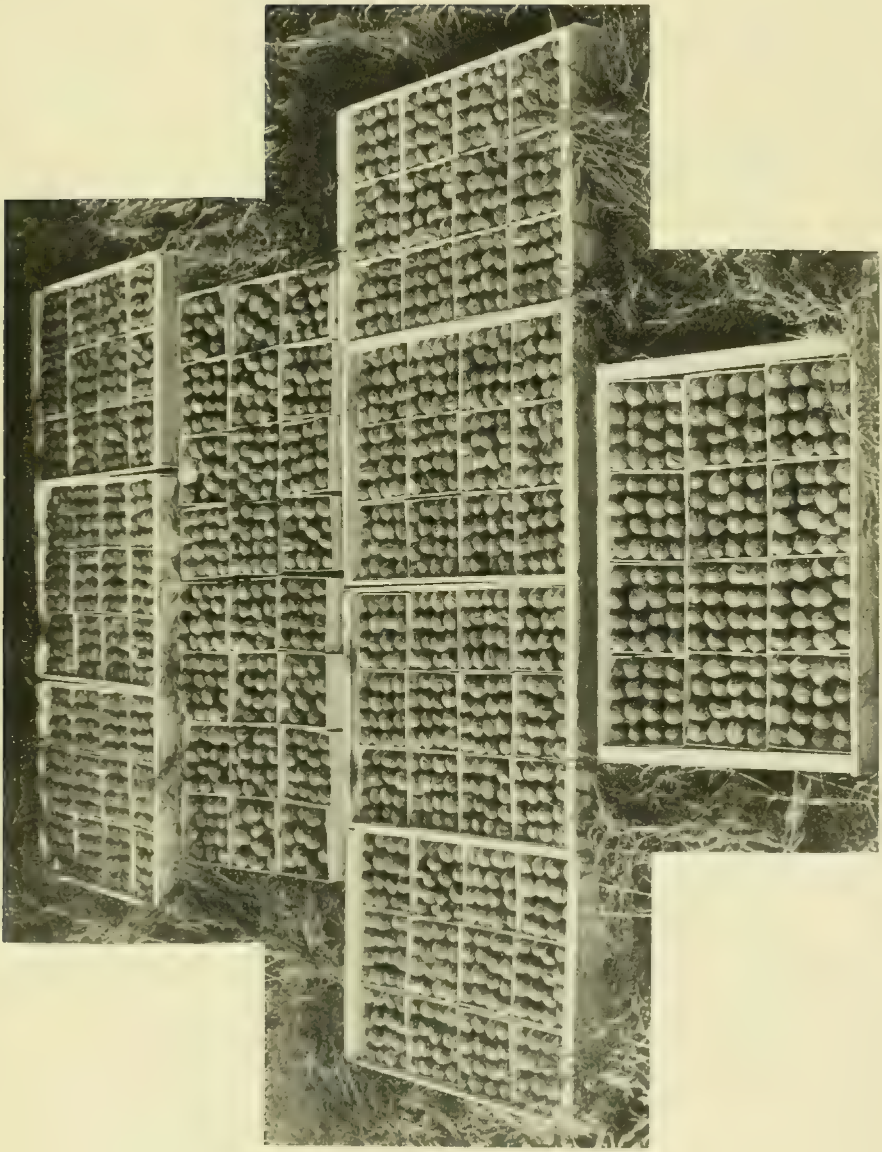
YAKIMA VALLEY FRUIT GROWERS' ASSOCIATION PACK AND GRADE RULES

Grades

"Extra Fancy." This grade shall consist of all perfect berries, Clark's Seedlings variety, picked at the proper stage of ripeness for shipping. All berries must show at least three-fourths red. Nothing smaller than a 5x5 and no stemless in this grade.

"Canning Stock." This grade to consist of berries irregular in shape, unpacked, but well colored, firm, clean, free from leaves, grass or other trash.

Other varieties, such as Nick Ohmer, Glen Mary, etc., designated as "soft" varieties, are to form a separate grade and called "fancy." This grade does not include the Clark's Seedling, which shall be packed in two grades only. The berries in this "fancy" grade shall be all perfect berries, picked at the proper stage of ripeness, well packed and topped with uniform berries. Nothing smaller than 5x5 and no stemless berries in this grade.



Clark's Seedlings, Grown at Kennewick, Wash. Shows method of facing.

Pack

As the strawberry is delicate, perishable fruit, it must be handled with the best of care from the time of picking until it reaches the consumer. The following rules are therefore laid down for packers and are complied with to the letter under the supervision of an expert inspector:

Each packer is registered under a number and furnished with a stamp, which is placed on each crate packed by him, and he is held personally responsible for the proper grading and packing of the fruit.

Each box is packed with berries as uniform in size as possible, and the face berries must not misrepresent the contents of the cup. Cups must not be filled with 5x5 and capped with 4x4.

Berries brought in from the field must be emptied out by the packer on a sieve constructed of wire or cloth, in order to allow the sand and dust to fall away from them.

Each cup is packed without bruising the fruit, so that there will be no settling of the berries.

The top of the box is faced with berries 16, 20, or 25 size.

Cups are filled so that top layer will show three-eighths of an inch above the top of the cup. Berries must not extend over the side of the cup.

The cups are carefully placed in the crate, using a sheet of paper to cover the fruit and keep out the dust. The lid is put on, dividing the space between the outside and the center of the crate. Cleats are used on all crates and the lid is nailed on through the cleat.

STRAWBERRY CULTURE IN THE PUGET SOUND COUNTRY

The basin of Puget Sound comprises that country between Canada and the southern boundary of Pierce county, Washington, and between the Cascade range and the Olympic mountains.

Soils

The contour is generally rolling and frequently cut by deep valleys. The soil is quite variable throughout, generally of glacial deposit. Considerable of this is a composition of gravel and clay, supplied with humus which proves excellent strawberry land. In some places, however, the soil is so thoroughly washed that nothing but gravel remains and the land is unfit for agricultural purposes. An example of this type of soil is found in the prairies immediately south of Tacoma and about Steilacoom. There are considerable areas of lake-bed deposit which, with the delta formations of the river valleys, are of silt and loam composition, which is very fertile and well adapted to strawberry growing. Most of these lands are new and well supplied with humus. Owing to the damp climate, potash is quite deficient. The heavier soils and those which have not been sufficiently drained are more or less sour and require applications of lime.

Climate

The climate of the Sound country is humid throughout. The winters are mild, with considerable cloudy weather and very little ice or snow. The summers are moderately warm, with cool nights.

Precipitation

The annual precipitation varies from 25 inches at the north to 55 inches at the south extremity of the Sound, being 35 inches at Seattle and 45 inches at Tacoma. Seventy-five per cent of the rainfall occurs during the months of November to April, inclusive.

Irrigation

Thorough cultivation conserves sufficient moisture without irrigation in practically all localities. There are, however, a few instances where sandy soils are benefited by light applications of water during the summer.

Districts

As in other sections of the country, the strawberry plantations of this section are generally within easy access of the centers of population. This is so, primarily, because of the convenience in securing help for the harvest. The islands and near shore lands show the greatest development by this industry, probably owing to the favorable influence of the

water in diverting the late spring frosts.

There are three principal strawberry-growing districts as commonly referred to. The Vashon Island district is a large island in the Sound between Tacoma and Seattle; the Lake Washington district comprises the east shore of the lake and adjacent country lying east of Seattle; the Bay Island district comprises the islands and shores of the south part of the Sound, principally near Tacoma. Many other sections are favorable for the industry, but are not yet extensively developed.

Varieties

The varieties commonly grown are the Magoon, Marshall and Clark's Seedling. Besides these the Warfield, Wilson, Gold Dollar and New Oregon all do well and are profitable.

Marketing

The various steam and electric roads, as well as the excellent service by boat lines, solves the transportation problem perfectly. The growers have access to several good canneries, which care for the surplus fruit.

In the Vashon and Bay Island districts the growers are well organized into cooperative associations for marketing their produce.

F. H. Burglehaus

STRAWBERRY GROWING IN THE WEST KOOTENAY DISTRICT, B. C.

The possibilities of successful strawberry growing in the Kootenay have been fairly well demonstrated to be one of the most profitable adjuncts to general fruit growing. The character of the soil, along with the ideal climatic conditions to produce a large crop of the highest quality berries in color and flavor, has been the means of creating considerable favorable comment from those capable of judging.

The yield and profits from strawberries in the Kootenays are quite varied, depending almost wholly upon the grower, the condition and preparation of the soil and the cultivation and attention given the patch. As an instance, the average yield per acre in this district has been estimated at less than 200 crates per acre, while individual growers have reported yields of from 400 to 600 crates per acre in a good season. Mr. O. J. Wigen, at Wyndall, has produced as high a yield as 14,000 pounds, or about 600 crates per acre, and an average of some 400 crates per acre, during a fair season, on some seven or eight acres which he devotes to the crop. Last season the berry crop in the Kootenay was badly affected by cutworms. In some instances the plants were completely ruined, while in others they were injured sufficiently to materially affect the bearing of the plants. Application of Paris green and bran in the proportion of one pound of Paris green to 50 pounds of bran, with about three or four pounds of brown sugar added to sweeten it, gave good results where it was applied to the patch in good time in the spring.

The varieties which are most commonly grown in the district for the factory are the Glen Mary, William Belt, Royal Sovereign and the New York. Those for shipping are the Magoon, Royal Sovereign and the Parson's Beauty; the softer of the berries being sold in crates locally. The Magoon is a good berry and is probably the most widely known. It is very dark-colored and is not so attractive when put up in jam as is the Glen Mary or William Belt, which are lighter colored with large light-colored seeds, giving them a very attractive appearance when put up as jam, especially when put up in glass. The Glen Mary, William Belt and New York yield somewhat larger crops than the Magoon.

Unquestioning the demand for the berries and the adaptability of the district for the growing of them, we must be attracted by the great variance of crop yields obtained. It will be the endeavor in the balance of this article to give the practices followed by the most successful growers in the district. It costs about 60 cents to pick and pack a 24-pound crate of strawberries. The total expense in growing a crate of strawberries is estimated at about $1.20 per crate, calculated on a 250-crate yield per acre. It will be seen that as the yield is increased the

cost of production per crate will be decreased, and consequently greater profits realized. The estimated cost of planting out and caring for an acre of strawberries is calculated at from $125 to $185 per acre, depending on local conditions and facilities.

The methods employed and the selection of the sites should receive the first attention. There are very few really poor sites for strawberry growing in the Kootenay, with perhaps the exception of those very light soils and those located too low, where the rise and fall of the water would affect them. Strawberries do best on a good, heavy silty to clay loam soil which contains a good supply of humus, or vegetable matter. They must have a well-drained soil. This last remark led a great many in the earlier days to suppose that strawberries would do best on an open sandy soil, but time has demonstrated that so long as the soil is well drained the heavier soils will yield the best and heaviest crops of berries. The preparation of the land before planting is a point upon which a great deal of the success or failure depends. In the Kootenay the newly-cleared land should be worked a year or two and enriched by the plowing under of green crops, preferably a leguminous crop, or an application of barnyard manure before setting out to strawberries. Poultry manure is one of the very best fertilizers for strawberries. Another important point in the preparation of the land before setting is to thoroughly level it down; all holes and hollows should be filled in by means of a scraper or split-log drag leveler. This implement is easily and quickly made at home and works wonders in leveling uneven sites. If strawberry plants are set on uneven land the growth will be very uneven, resulting in a great many of the plants being either killed out by water settling in the hollows or by the heaving action of the frost.

Spring planting is best. Select the plants from the runners in the bearing patch. Select the plants from the first two plants formed on the new runners. These will be much stronger and better than the third or fourth plants on a runner. Where large numbers of plants are required the planting out of a special propagating bed is advisable. The plants set in the bed are allowed to throw as many runners and set as many new plants as they will. In the spring, when ready to plant, the whole bed is dug up and the best of the plants selected for planting. There is a great scope for selection of the best and most prolific strains of the varieties by marking the best producing plants in the bearing patch and then propagating from these. There is one man who by this practice increased his yield from 8,000 pounds to 16,000 pounds per acre.

The plants are generally planted in what is known as the matted-row system, the plants being set 18 inches in the row and the rows set 3½ to 4 feet apart, depending on the growth of the variety being planted. In new land, weedy land or on poor, light soil, the hill system of planting is followed, as it gives better results. In this system the plants are generally set two feet apart in the rows and the rows three feet apart. This system allows far better cultivation and is not as hard on the soil's water supply as is the matted-row system. The patches are allowed to crop two or three years. The third crop should only be taken when the ground is rich and clean. Strawberries are heavy feeders and will leave the ground in poor condition if grown too long, especially where no manure of a lasting nature is supplied. As the berries are, as a general rule, grown as an intercrop in the orchards, they should not be allowed to remain too long, as this will affect the growth of the fruit trees. In young orchards strawberries should not be planted closer than four feet from the trees, and this distance should be increased as the trees become older. Great care should be exercised during the first fall in not causing the fruit trees to make late growth by the cultivation which is necessary in the berry patch in order to develop good, strong crowns for the following season's crop. Irrigation is not

always needed in the West Kootenay district, but where it is convenient it should be in readiness for the insurance of a good crop. An application of water to the patch just after the first or second picking will often double the yield. Mulching the berries to prevent them from becoming soiled during the picking season is very important if the berries are to be shipped. This is one of the serious problems confronting the growers in some parts of the district where no straw or slough grass is to be obtained locally. In some parts ferns are cut and used to good advantage. Others cut clover and mulch the patches with it, allowing it to remain and be worked into the soil as a fertilizer. This is especially good during the last year of the berry patch, which is plowed immediately after the crop is picked.

M. S. MIDDLETON, B. S. A.,
Assistant Provincial Horticulturist, Nelson, B. C.

COST OF GROWING ONE ACRE OF STRAWBERRIES

While the strawberry crop is one of the most profitable to grow, it is also one of the most expensive, and in order to give those who may desire to begin growing strawberries for sale some idea of the cost of producing this fruit, the following estimates, furnished by representative growers, are given:

	Grower									
	1	2	3	4	5	6	7	8	9	Average
Rent of land	$30 00	$10 00	$10 00	$10 00	$10 00	$15.00	$30 00	$ 6 00	$ 5 00	$14 00
Preparation of land	5 00	6 00	3 00	5 00	8.00	2 50	5 00	4 00	6 00	4 94
Fertilizers	50 00	7.50	25 00	25 00	20 00	30 00	22 50	10 00	30 00	24 45
Plants	30 00	.....	25 00	35 00	24 00	36 00	15 00	20 00	17 42	25 30
Planting	5 00	7 00	3 00	10 00	5.00	7 50	4.50	5 00	6 00	58 67
Cultivation	30 00	25 00	5 00	25.00	15.00	9 50	25 00	7.00	2 00	17.55
Mulching (winter)	15.00	25 00	4.00	25 00	10.00	16.50	6.00	7.00	12 00	13.39
Additional expenses, including crates boxes picking and marketing	132 00	1.50	......	100.00	5 00	105 00	15 00	70.00	1 58	53.76
Total	......	......	......	......	......	......	......	......	......	$209.56
Average crop obtained	Quarts 8,000	Boxes 3,000	Boxes 4,500	Boxes 4,000	Boxes 6,400	Boxes 5,000	Quarts 8,600	Boxes 4,000	Boxes 7,000	Boxes 5,611

ESTIMATED COST OF PRODUCTION, WITH AVERAGE YIELD AND PROFIT, FROM ONE ACRE OF STRAWBERRIES

Interest and tax on land (2 years)	$4.00	
Plowing	3.00	
Harrowing	3 00	
Fertilizer	50.00	
Plants	30.00	
Setting plants	10 00	
Cultivation	50.00	
Training and cutting runners	10.00	
Fall mulch	10 00	
Adjusting mulch for summer	10.00	
Total cost of growing	$180.00	
Crates and baskets	30 00	
Cost of picking 8,000 quarts at 1½c	120.00	
Total outlay	$330.00	
Value of an average crop, 8,000 qts. at 8c (wholesale)		$640.00
		330.00
Net profit		$310 00
Annual profit		155.00

The above is believed to be a conservative estimate under average conditions. In some cases the profits have been much greater; in others less. The grower who retails his crop or grows fancy berries for wholesale will consider the above price as being low, while the grower who ships ordinary berries to distant markets to be sold by commission men will doubtless regard it as slightly above the average.

H. F. HALL,
New Hampshire Agricultural Experiment Station, Durham, N. H.

INTENSIVE METHOD FOR HUMID SECTIONS

One method of setting a field of strawberries for which claims have been made for extraordinary yields is that of T. C. Kevitt, of Athenia, N. J.

Mr. Kevitt's method is to set the plants in beds 4 feet wide and 20 to 25 feet long, five plants to the cross row, making a plant occupy one square foot of ground. Runners are not permitted to grow, so that the whole strength of the plant is thrown into the production of fruit. Between these beds paths 18 inches wide are run, and from these the picking is done, necessitating a reach by the picker of two feet to the center row. This method of setting requires 33,975 plants to the acre, or 1,940 plants to each 25x155-foot bed. In this way plants do not choke each other, nor do runners sap the strength of the plant, which is allowed to develop a strong root and crown. Plants, instead of running out in two or three years, will yield good crops for eight to ten years, according to the originator.

STRAWBERRIES IN THE UNITED STATES

The amount of acreage in the United States devoted to the growing of strawberries, as reported by the census of 1910, is as follows:

Scale—1 mm=1,000 acres.

STRAWBERRY DISEASES

Anthracnose

Gloeosporium fragariae Mont.

According to C. L. Shear, pathologist of the Bureau of Plant Industry, United States Department of Agriculture, this disease does not occur in America.

Black Heart or Frost Injury

The cultivated varieties of strawberries and raspberries are more or less subject to frost injury, which manifests itself by producing a blackened center in these flowers. In severe cases, all flowers forming a cluster may be found affected, especially in varieties where most of the blossoms open at one time. Night frosts are capable of great injury by destroying the styles of the flowers and thus preventing the fruit from being formed. In some instances, a few styles only may be killed and the result will be a crippled, malformed fruit, which does not recommend itself by its appearance to the buyer. It has been found, especially in the case of strawberries, that the injury may be largely prevented by covering all early-flowering varieties at night with straw or loose litter of some kind. The harvest may thus often be increased from 10 to 20 per cent and more. Raspberries may be planted between sheltering hedges, or they may be covered over night with cheesecloth. Where these suggestions may not be practicable, spraying with cold water early in the morning before the rays of the sun take effect has been proved a useful preventive.

The lighting of smudge fires and keeping them alive throughout cold nights has also proved quite successful.

H. T. Gussow,
Experiment Farms Reports, 1911.

Black Root

A rather indefinite trouble, characterized by the blackening and ultimate decay of the roots of plants during the second year after setting. It usually starts at the season when new growth is beginning in spring, and affected plants may put forth leaves and blossoms only to die later on. The trouble appears to be closely associated with winter injury and unfavorable soil conditions, but nothing definite is known about the condition at the present time.

B. O. Longyear,
Colorado Report, 1910.

Frost Injury. See *Black Heart.*

Leaf Blight. See *Leaf Spot*, this section.

Leaf Spot

Mycosphaerella fragariae

H. S. Jackson

The only fungous disease of the strawberry occurring in Oregon that has been thoroughly studied by pathologists is the disease known as the strawberry leaf spot or blight. This disease is nearly always present to a greater or less extent in every field. It is not always serious and, in fact, is rarely considered by Oregon growers to cause sufficient damage to need special treatment. In many cases, however, it causes more damage than is realized, and hence is considered of sufficient interest to warrant a discussion in this connection. All of the cultivated varieties may be attacked, though many are so resistant as not to be seriously affected.

The disease affects the foliage primarily, making its first appearance on the plants as minute purplish spots more or less thickly scattered. (See Fig. 1.) These soon enlarge and the center becomes pale gray or nearly white in color. The margin, however, remains purple, shading into brown towards the lighter area in the center. When numerous these

Fig. 1. Strawberry Leaf Showing Spots Caused by the Leaf Spot Fungus.

spots may run together. In severe cases the leaves may gradually turn yellow, wither and die. In certain instances the disease has been reported as being so severe that the plants are killed.

Cause

This disease is caused by a fungus known technically as *Mycosphaerella fragariae*. The mycelium grows in the tissue. killing it and forming the characteristic spots. This fungus is propagated by means of summer and also by winter spores.

In the Northwest it seems to spread all winter and it is possible that in this region the summer spores are sufficient to keep the fungus perpetuated.

Control Measures

Only healthy plants should be set. Plants should be secured, if possible, from fields where the disease was not present. In any case all diseased leaves from plants should be picked off before planting. Cutting and burning the foliage after harvesting the fruit, as carried on in some sections of Oregon, is an excellent practice, since it destroys many leaves affected with the disease. When the disease is severe, spraying may be practiced. Use Bordeaux mixture 4-4-50. In Oregon three sprayings are suggested for trial, two in early spring before the first fruits are half grown, and another about the first or middle of September.

Powdery Mildew of the Strawberry
Sphaerotheca castagnei Lev.

The disease known as powdery mildew is not common in this country, but in one locality in Ontario, at least, it has done considerable harm, and as it may soon spread, it should be referred to here. When this disease is bad, it covers the fruit with mildew, making it unfit for sale or consumption. The grower does not usually notice the disease until it affects the fruit, but as a rule it starts on the under side of the leaves, which eventually curl up, and in order to control it, it must be treated early, as the plants cannot be sprayed satisfactorily when the fruit is developing, although ammoniacal copper carbonate might then be used. For spraying the foliage, Bordeaux mixture may be used or flowers of sulphur in the proportion of one part lime and two parts flowers of sulphur. It is important that the underside of the leaves should be well covered, and even the soil, so that spores may be destroyed. These are scattered early in the spring from the tiny sacs in which they are contained during the winter. They soon germinate and attack the leaves. As this disease spreads only on the surface of the leaves, it is readily controlled if treated at the proper time.

W. T. Macoun,
Central Experiment Farms Bulletin 62.

STRAWBERRY PESTS

Introduction
Strawberries and Insects

J. B. Smith

In the course of this article the terms "staminate" and "pistillate" are used in referring to varieties, and it may be well to explain the meaning of these terms and their bearing on fruit production.

The term "staminate" as applied to a strawberry flower means that around the central disc-like protuberance there is a series of stems or thread-like processes, the filaments, bearing an enlargement at tip, the anther—together called stamens. On the anthers the pollen is produced, and strawberry flowers so provided are said to be perfect or "staminate.'" When these stamens are absent, and only the yellow disc-like center bordered by the white petals is present, the flowers are said to be imperfect or "pistillate."

A bed of pistillate plants remote from others or sheltered from insects could never produce satisfactory, if any, fruit, and pistillate varieties only are never planted in one area. Staminate varieties may be isolated in any way and will produce perfect fruits, provided the pollen is brought into contact with the pistils.

Where a mixture of varieties is planted, the pistillate varieties will usually bear quite as freely as the others, because the staminate varieties bear a great excess of pollen and have sufficient not only for their own needs, but for many others besides, provided only that there is a car-

rier to bring the pollen to the plant that needs it.

Probably every strawberry grower has noticed that when his plants are in full bloom there are a large number of insects on the flowers, and he may have noticed that many of these are bees of various kinds, large and small. But probably few have ever realized what an important function these insects really exercise on the strawberry bed, and how much they are indebted to these insects for the crop to be harvested later.

Many insects visit strawberry flowers for what nectar they can obtain, and in moving about among the blossoms, the sticky pollen adhering to the surface of the bodies is carried to other plants and left on the pistils, where it exercises its specific effect. But bees are not mere casual visitors; they need pollen in their domestic economy and they need honey as well. They visit the staminate varieties and the hairy surface of the body becomes absolutely loaded with pollen as they roll around in the blossoms. In this process the blossoms so visited are fertilized, and then the bees visit the other blossoms, and in every blossom so visited they leave some grains of pollen in return for favors received, and thus fruit is produced.

And as a gatherer of pollen the hairy coating of the bees is especially adapted, for the hair is not a single, simple stalk or cylinder, but is furnished with processes, teeth and branches in great variety, so that the pollen grains become caught and entangled in the mass and retain their position until rubbed off or deliberately combed out by the bee.

Over a single short row of berries I collected over 200 specimens of insects, mostly bees, by simply sweeping a net to and fro about six inches over the bed.

It is well for the grower to understand that while some insects exact a tax from him, others add to his income without charge and without recognition.

It explains also why staminate or pollen-bearing varieties are absolutely necessary in any scheme of planting, even though their presence continues the attacks of some insect species that cannot subsist on pistillate varieties.

New Jersey Experiment Station Bulletin 225.

Chafer Beetle. See *White Grub*, this section.

Chinch Bug. See *False Chinch Bug*, this section.

Cutworms—Various Species

These may appear in the spring in the strawberry bed or amongst newly set plants, and do great damage. To destroy them place poisoned bran bait under boards scattered over the field.

The bran mash may be made as follows: Use one-half pound of sugar or molasses per gallon of water and use enough of such sweetened water to dampen 50 pounds of bran. Add one-half pound of Paris green or white arsenic by sprinkling lightly over the surface of the bran, while vigorously stirring so as to mix the poison thoroughly with the mass. Place a tablespoonful near the base of the plants. It will keep better if placed under a board.

Dagger Moth

Apatela oblinta

One of the dagger moth caterpillars which is rather common in strawberry beds. The full-grown worms may be found in early September. The caterpillar is about one and one-quarter inches long, of a deep, velvety, black color, with a transverse row of tubercles girding each segment. A tuft of short, stiff hairs radiates from each tubercle, those from the topmost tubercles being red in color, while those from the lateral ones are yellowish or mixed with yellow. Two rows of bright yellow spots extend along the back, one on each side, and below these a crescent-shaped, bright yellow band ornaments each segment. The breathing pores are white. Early in September it draws together a few leaves or other light fragments, and by webbing them together with silk, constructs a coarse cocoon in which it passes the winter. The following June it issues as a gray moth, with a zigzag line of blackish, dagger-like points crossing each fore-

wing in a transverse direction near the outer border. The hind wings are white.

This is not a serious pest and remedial measures seem unnecessary.

H. A. Gossard,
Ohio Bulletin 233.

False Chinch Bug
Nysius angustatus Uhl.

General Appearance

The adults are very small grayish-brown bugs, about one-eighth of an inch long. The young are somewhat lighter in color, having reddish-brown abdomens and lacking wings. The legs and antennae appear very long and are dark.

Life History

The eggs are deposited in the spring and early summer by the adults which have hibernated. The young are dull gray or brownish-red, and collect in great numbers upon the host plants. The life cycle is short, there being many successive broods during the year.

Distribution

Throughout California. A common plant pest.

Food Plants

Besides strawberries, grapevines, lettuce, potatoes, apple foliage, the cruciferae.

Control

As this bug breeds largely upon wild plants, such as mustard, radish, purslane, etc., clean culture should be practiced to eliminate these food plants.

Soap emulsions and tobacco sprays are excellent remedies. Pyrethrum is also recommended, but is too expensive for large plantings.

E. O. Essig

False Worm. See *Strawberry False Worm.*

Fuller's Rose Beetle
Aramigus fulleri Horn.

General Appearance

The adults vary from a gray to a very dark brown in color and from three-eights to one-half an inch in length. The eggs are pale yellow and laid in rows. The larvae are milky white and without legs. The pupae are also white.

Life History

The eggs are laid in secluded places close to the ground. The young white grubs live under ground, doing great damage to the roots of many plants. The adults when seen during the day are very sluggish. They have no power of flight. The damage done is usually unknown owing to the fact that the larvae work under ground and at night.

Distribution

California, eastward.

Food Plants

Strawberry roots.

Control

The larvae, like all subterranean pests, are difficult to control, but thorough cultivation and hoeing close to the plants are great aids. In light sandy soil, carbon bisulfid is efficient. The adults being unable to fly are easily kept from trees by a cotton or tanglefoot band around the trunk.

E. O. Essig

Grain or Strawberry Thrips
Euthrips tritici Fitch.

Very minute. The color is yellow with orange colored thorax.

Life History

The eggs are very minute, globular in shape and red in color. They are inserted within the tissues of the host and hatch in a few days. The nymphs or young greatly resemble the adults, and begin to feed at once. The principal damage is done to the blossoms. The strawberry especially suffers, the pistil being the portion of the bloom destroyed. The winter is probably spent in the soil as in the case of the pear thrips.

Distribution

General.

Control

Seldom destructive enough to warrant control, when necessary the sprays for pear thrips (except whitewash) are effective in controlling this pest.

E. O. Essig

Grape Colaspis
Colaspis brummea

H. A. Gossard

The grub of this species is found feeding on the roots of strawberries during the fall, winter and spring. It has on the underside of each legless joint a pair of fleshy appendages resembling legs, each tipped with two or three stiff hairs. The beetles are about one-fifth-inch long, of a pale yellow or straw color, the wing covers being sculptured with alternating elevated ridges and depressed lines or rows of punctures, or dots, like fine pin pricks. They probably feed on the roots of other plants, so that fall plowing for their destruction would probably not much avail. Spraying with arsenicals to kill the beetles when they are feeding on grape would appear to be more dependable. They appear on grape foliage during July and August.

Graphops Nebulosus

The larvae of this small, uniformly brownish beetle injures the roots of the strawberry much the same as the strawberry root borer. It has a coppery, metallic luster and is about one-eighth inch long. The grubs of these various species are practically indistinguishable by any ordinary method of separation. The beetles appear in June and July and deposit eggs for the brood of larvae, which works in the late summer and fall. These larvae remain in the ground over winter, to continue damage the following spring.

Distribution

For Control, see *Strawberry Crown Borer.*

Goldsmith Beetle
Cotalpa lanigera

*This is, without doubt, one of the most beautiful of all our leaf-eating beetles. It is nearly an inch in length, of a broad, oval form, with the wing-cases of a rich yellow color and pale metallic lustre, while the top of the head and the thorax gleam with burnished gold of a brilliant reddish cast. The under surface has a polished coppery hue, and is thickly covered with whitish, woolly hairs; this latter characteristic has suggested its specific name, *lanigera*, or wool-bearer.

This insect appears late in May and during the month of June, and is distributed over a very wide area, being found in most of the northern United States and Canada; and, although seldom very abundant, rarely does a season pass without some of them being seen. During the day they are inactive and may be found clinging to the underside of the leaves of trees, often drawing together two or three leaves and holding them with their sharp claws for the purpose of concealing themselves. At dusk they issue from their hiding-places and fly about with a buzzing sound among the branches of trees, the tender leaves of which they devour.

The pear, oak, poplar, hickory, silver abele, and sweet-gum all suffer more or less from their attacks. Like the common May-bug, this beautiful creature is attracted by light, and often flies into lighted rooms on summer evenings, dashing against everything it meets with, to the great alarm of nervous inmates. In some seasons they are comparatively common, and may then be readily captured by shaking the trees on which they are lodged, in the daytime, when they do not attempt to fly but fall at once to the ground.

The beetle is short-lived. The female deposits her eggs in the ground at varying depths during the latter part of June, and, having thus provided for the continuance of her species, dies. The eggs are laid during the night, the whole number probably not exceeding 20; they are very large for the size of the beetle, nearly one-tenth of an inch in length, of a long, ovoid form, and a white translucent appearance.

In about three weeks the young larva is hatched; it is of a dull white color, with a polished, horny head of a yellowish brown, feet of the same hue, and the extremity of the abdomen lead color. The mature larva is a thick whitish, fleshy grub, very similar in appearance to that of the May-bug, which is familiarly known as "the white grub." It lives in

*Saunders, *"Insects Injurious to Fruits."*

the ground and feeds on the roots of plants, and is thus sometimes very destructive to strawberry plants. It is said that the grub is three years in reaching its full growth; finally, it matures in the autumn, and late the same season or early in the following spring changes to a beetle. *Cotalpa lanigera* is found both in Eastern United States and Eastern Canada, and Northern Mississippi Valley states.

Greenhouse Orthezia

Orthezia insignis Dougl.

General Appearance

Body ochreous to dark green, covered with plates of white waxy secretion, which are extended posteriorly in a large rectangular plate, to hold and protect the eggs and young. Length 1.5 mm. Males are smaller and darker in color with two long white wax filaments posteriorly.

Life History

There are several generations a year. The eggs of the female are carried in the white egg-sac fastened to the posterior end of the abdomen. The young females vary from yellow to green in color. As they grow the white covering forms around the edges and as a distinct middle longitudinal ridge. When full grown the bodies are completely hidden. All stages are active.

Distribution

In greenhouses throughout the entire state and country.

Food Plants

Numerous including strawberry and tomato.

E. O. Essig

Ground Beetles

Carabidae

It sometimes happens that an insect which is, under normal conditions, harmless or even beneficial, becomes under unusual conditions more or less pestilent and then offers great difficulties in control.

"Ground beetles," belonging to the family *Carabidae*, are as a rule predatory in character, and their presence in cultivated fields is to be looked upon as rather an advantage than otherwise. But there is one group of the series which, under certain conditions, varies its diet somewhat, and in the adult stage may turn to vegetable food, and chiefly seeds. It is not uncommon to find in late summer or early fall, the large black species of *Harpalus* on seeds of grasses and of rag-weeds, and sometimes they are present in very large numbers.

The beetle is somewhat shining bronze-black in color, with grooved wing-covers and is less than half an inch in length. It is active, runs readily at all times, and flies readily at night. It feeds only at night and eats only the seeds of ripening berries, incidentally mutilating them so much that their market value is destroyed.

Control

Insecticide applications after the insects have begun injury are manifestly out of the question.

Injury from ground beetles can never be very wide-spread, and will always be temporary when it does occur.

June Bug. See *White Grub*.

Leaf Beetle. See *Strawberry Leaf Beetle*.

Leaf Feeders

There are a number of species that occasionally feed on strawberry foliage in numbers sufficient to attract attention. Notable among these are the larvae or slugs of certain saw-flies. These resemble caterpillars in appearance, but have one more pair of legs on the middle of the body and tend to curl up on the surface of the leaf. They usually feed in colonies and may be very numerous on a single plant, while all around the plants are free.

All these slugs succumb very readily to arsenate of lead and, indeed, to almost any contact insecticide like hellebore, finely powdered tobacco, or even air-slaked lime. This is of advantage for these slugs are apt to make their appearance, when they come at all, when the berries are well advanced and when arsenical poisons are not indicated.

J. B. Smith,
New Jersey Experiment Station Bulletin 225.

LEAF ROLLER. See *Strawberry Leaf Roller.*

MAY BEETLE. See *White Grubs.*

Obsolete—Banded Strawberry Leaf Roller

Archips obsoletana

Habits similar to strawberry leaf roller, which see. Also similar methods of control.

ROLLER. See *Strawberry Leaf Roller.*

ROOT LOUSE. See *Strawberry Root Louse.*

ROSE BEETLE. See *Fuller's Rose Beetle.*

Saw Fly

Harpiphorus maculatus

The larva of this insect is a pale green worm which works on the foliage and is distinguished from other worms which affect the strawberry by the number of legs (22). See *Leaf Feeders.*

Spittle Insect

Aprophoninae sp.

Small bugs which lay their eggs in the stems of the plants in the autumn and hatch in the spring. A clear viscid liquid is secreted at the anal end and by a continual thrashing about of the tail the insect brings in air which produces the froth or "spittle" which so attracts curiosity to these bugs. They are sought after by certain wasps who drag them out of their froth to provision their nests.

*According to Melander they are not materially harmful unless in great numbers. On account of their conspicuous "spittle" they may be gathered by hand and destroyed most economically. They are found usually near the base of the plant.

Howard, *The Insect Book.*

Strawberry Crown Miner

Aristotellia sp.

A. L. LOVETT

This strawberry crown miner is present in the Pacific Northwest about everywhere that the strawberry is grown. In many localities fields have been observed which were severely injured and an examination showed this pest to be wholly responsible for the trouble.

*Melander Bet. Frt., Dec. 1912.

While the names of these various insects infesting the strawberry roots may at first appear confusing, a glance at Fig. 1 will aid in distinguishing the work of this pest. The larvae are not grub-like, but are longer, more slender, of a distinct reddish color and with a brown head. When mature they are less than half an inch in length. They feed almost entirely within the crown, usually mining just within the bark, constructing long tunnels either up and down or around the crown. Others tunnel directly through the crown or else up and down the cork-like interior of the root. Still other larvae are found feeding in the whorl of leaves at the growing tip of the crown and a few have been observed mining in the petiole of the leaves.

Fig. 1. (*Aristotellia sp.*) Strawberry crown, showing the burrows of the crown miner. Also a mature larva in its cocoon in the crown. (Original.)

The adult of this crown miner is a small moth, resembling very closely in general appearance the peach twig miner, *Anarsia lineatella.* It is a weak flier and very sluggish in its movements. The eggs are deposited on the sheaths about the crown, on the underside of the leaves, and along the leaf petioles. They are usually pushed well down among the fine hairs. The egg is white with a dull lustre, a slight area at the smaller end being transparent. The surface of the egg is

ribbed and pitted, very much resembling the hull of a peanut. The egg is elongate, flattened at the larger end, the edges rounded. From the base end it gradually increases in size to near the middle, then slopes down to a blunt rounded point. It measures .55 mm. long and .29 mm. wide.

Remedial Measures

Plowing up the infested plants is the method of treatment recommended.

It would seem that possibly the young larvae on hatching from the egg might feed on the leaf or petiole before entering the crown and could be successfully poisoned with an arsenical spray.

Strawberry False Worm

Harpiphorus maculatus Nort.

This insect is sometimes known as the strawberry slug. The adult saw-flies are a little less than one-fourth of an inch long with a one-half inch wing expanse. The pupa is of a dull greenish-white color. The larvae are a little over one-half inch in length and of a greenish-yellow color.

There is but on brood each year, the larvae hatching at about the time the first blossoms appear on the plants and continuing until the berries are ripe.

By thoroughly dusting fresh and pure pyrethrum among the plants, we can kill a large per cent of the worms, and hold them in check so as to prevent any serious damage. As this substance is absolutely harmless to man, it can be used with perfect safety at any time, even when the fruit is fully ripe and ready to pick. Two or three applications may be necessary to kill the bulk of the larvae in severe attacks. This method is too expensive for anything but home patches or those supplying a home market.

The larvae may be practically all killed and further damage prevented, by thoroughly spraying the plants once or twice immediately after the larvae appear and before the first berries are more than one-third grown, using for this purpose either fresh powdered hellebore in the proportion of one pound of hellebore to each three gallons of water, or one pound of Paris green and three pounds of fresh lime in 150 gallons of water.

Powdered white hellebore, which must be fresh and unadulterated, is the best and safest all-around substance to use, since it kills the larvae readily, is less poisonous to man than the arsenics, and soon looses its strength or poisonous property after it has been sprayed on the plants. Hence there is no danger connected with its use if applied as directed.

J. M. Stedman,
Missouri Experiment Station Bulletin 54.

Strawberry Leaf Beetle

Typophorus quadrinotatus Say

J. B. Smith

* This is a small, chunky beetle, shining blackish in color at first sight; but when more closely examined it is found that the color of the upper surface is really a very dark, smoky clay-yellow and that there are two oblique black bars on each wing cover. The adult appears in the fields on the leaves during the early days of May, and lingers until after the 25th, in ever-decreasing numbers, eating irregular holes in the tissue. These holes vary in size and are so close together that the plants look as if loads of shot had been fired into the foliage at short range. The result is a drying and withering of foliage.

No life history.

Remedial Measures

As the insects feed openly and eat the entire leaf tissue, arsenical poisons are indicated, and of these arsenate of lead is the most satisfactory and effective. Applied at the rate of one pound in 25 gallons of water, as soon as the beetles are noticed, a single application will be sufficient. A very prompt treatment is desirable as the spray should not be applied after the fruit is more than half grown.

Strawberry Leaf Roller

Ancylis comptana Frohl.

Origin and Appearance of the Insect

This leaf roller seems to be of European origin, and is one of those species which in its native home is not seriously

* N. J. Ex. Sta. Bul. 225.

injurious, but in its new surroundings frequently outruns its natural checks. At the present time it extends from Canada to Virginia and probably even further south, and westward to the Mississippi valley, very often in harmful numbers. In the adult stage, it measures with expanded wings about three-fifths of an inch. Its color is light reddish brown, the forewings streaked with wavy darker brown and white lines.

Life History and Habits

This moth makes its appearance in the strawberry fields in early May, and may be expected in full force about the middle of and extending up to June 1st.

The insects mate soon after their appearance and egg-laying begins at once. Larvae hatch from these eggs in from five to seven days, and at once make their way to the upper surface. At this time the minute creatures are light green in color, with a proportionately large head and rather long hair. When first noticed they are about an eighth of an inch in length and are feeding along the midrib or a large vein. For a day or two the minute caterpillar feeds thus without protection, gnawing into the vein or alongside so as to weaken the tissue, and then it begins to draw the upper surfaces of the leaf or lobe together by means of fine silken threads, until there is a complete fold that forms a shelter for its maker.

It feeds continuously within its shelter, and improves it by making the fold more complete and more secure, and sometimes actually making a roll of an entire leaf.

The life cycle is about 45 days. Three broods hatch during the summer but the last does not complete its transformation until the following April.

The important parts of this record are that the eggs are laid on the underside of the leaves; that the larvae wander to the upper surface as soon as hatched and, for a day or two, feed openly on this upper surface, and that for the rest of their growing period the insects feed in a shelter that cannot be reached by any effective insecticide.

Injuries Caused

Although this is best known as a strawberry pest, it is not confined to that plant, but attacks blackberry and raspberry as well. While the first brood is almost confined to strawberries, the second and third may be more abundant on blackberry and raspberry, and, at all events, their injuries on these plants are all caused after midsummer. On strawberries only the first brood is really injurious and the middle broods seem better controlled by natural checks.

Each of the adult female moths lays an average of about 70 eggs, and a single larva is sufficient to spoil a small leaf.

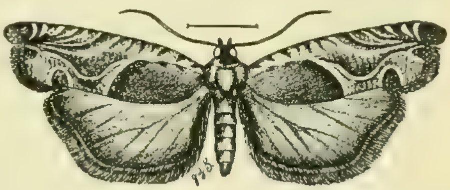


Fig. 1. Strawberry Leaf Roller.

On varieties in which the foliage is thin and scant, the injury is serious, and may reach 75 per cent of the total crop and an impairment of 25 per cent in the value of the remainder.

Remedial Measures

Destroy all old leaves in the fall and promptly turn under any beds not longer in use.

Spray with arsenate of lead, four to five pounds to 100 gallons of water. *This must be done at the time the eggs begin to hatch*, so that the young larvae will get the poison before they roll the leaves.

As for the apparatus, any outfit that gives a fine spray under good pressure will answer. On small patches a knapsack pump with vermorel nozzle will serve every purpose. A barrel pump mounted on a cart will do for two lines of hose, and a geared machine will serve to spray four rows at once.

Strawberry Root Borer

Sesia rutilans Hy. Edw.

A. L. Lovett

This root borer is a serious pest of the strawberry, occurring in the North-

Fig 1 Strawberry Leaf Borer (*Sesia rutilans*) adult moths. (Original.)

west nearly everywhere the strawberry is grown. The elongate, white larva, with brown head and darker biting jaws, feeds on the interior of the crown and tap root of the strawberry plant, eating out the entire heart. The plant, as a result, looks sickly, and when pulled up will often break just below the crown, exposing the tunnel filled with frass and excrement and often the larva itself. The adult insects are clear-winged moths. (See Fig. 1.)

Remedial Measures

Dig up and destroy infested plants, preferably in late fall or early spring.

Fig 2 Larva of Strawberry Root Borer. (Original)

Strawberry Root Louse

Aphis forbesi Weed

Except for a brief time in the spring when the young lice are working their way down from the leaves, where they hatch, to the crown of the plant, the strawberry root louse spends most of its time upon the roots of the strawberry, whither they are carried by ants which feed upon the sweet excretions of the aphids.

The presence of the lice may be detected by the failure of the plants to mature fruit and by the dying of plants in spots in the beds. Suspicion should be aroused also when numerous nests of brown ants appear in the strawberry beds after the first week in April.

The aphids are very small, about one-twentieth of an inch long, blue black in color and pear-shaped, tapering toward the head.

Food Plants

This species of aphis is found only on the tame strawberry, not even the wild strawberry in the neighborhod of infested tame ones being attacked.

Life History

Sometime in late October or early November the root louse deposits its eggs along the stems and ribs of the green leaves, where they remain until the latter part of March or April, when they begin to hatch out. The eggs are very small and shiny black, about one-thirty-fifth of an inch long. The first brood feeds upon the tender green leaves, slowly working their way down to the crown of the strawberry. They reach their growth in about 15 days.

Ants are largely responsible for the presence of the aphids on the roots of the plants. The aphids themselves do not seem to be able to get to the roots. But in late April ants begin to appear in the strawberry bed and are seen busily carrying the young lice to the roots of the plants, where they have provided quarters by excavating galleries under the crown of the plant, and along the radiating roots. The ants care for the aphids all summer, sometimes carrying them from one plant to another when they become too thick on the roots of any plant.

Distribution

The insects are spread in three ways: first, by the sale of plants which are already infested; second, by flight of the winged aphids; third, by ants.

Natural Enemies

This species of aphids has two natural enemies: The common ladybird beetles and their larvae which feed upon the lice, and the parasitic fly which lays its

eggs upon the lice, hatching into a grub which feeds within the body of its host, eventually emerging as an adult through a large circular opening in the body of the louse. These two enemies dispose of considerable numbers of the pests, but not enough usually to constitute an important factor in control.

Control

The first consideration in prevention is clean plants on clean land. If land has become infected, rotation should be practiced with crops requiring constant cultivation. If corn and melons are the rotation crops, care should be taken that they are not infested with root lice, for while the strawberry root louse is not found upon these plants they might spend a season there if the ground is badly infested with them to begin with.

When plants are purchased from a nursery the utmost care should be taken that they are clean of all lice. If none are introduced of course none will appear. The best plan is to buy from a region where as yet no root lice have appeared. In this way it may be possible to keep them out of new territory. Compel the nursery man to guarantee freedom from pests. If it is impossible to get plants free from lice they may be disinfected.

The following discussion of a method of disinfecting strawberry plants is reproduced from Bulletin 49, Delaware Experiment Station, by E. Dwight Sanderson:

Disinfection of Plants

All methods of disinfection must be applied after the aphis eggs have hatched (first week in April), as none of them have been found to kill the eggs. Inasmuch as the weather conditions upon which depends the time of planting also determine the time of hatching of the eggs, but little inconvenience will usually be experienced by waiting for all the eggs to hatch. The plants will need to be carefully gone over and the eggs examined with a magnifying glass to see that they have hatched before disinfecting can safely be commenced.

1. Dipping

In dipping plants they should be thoroughly submerged, as a few lice will be found both on the leaves and roots at almost any season of the year.

Kerosene Emulsion

Dr. C. M. Weed states that he successfully disinfected plants in Ohio by dipping in dilute kerosene emulsion. This may be made according to the following formula:

Kerosene, two gallons; whale-oil soap (or one quart soft soap), one to two pounds; water, one gallon. Dissolve the soap in the water by boiling, and add, boiling hot, away from the fire, to the kerosene. Agitate violently for five minutes by pumping the liquid back upon itself with a force pump and direct-discharge nozzle throwing a strong stream. The mixture will have increased about one-third in bulk and have become about the consistency of cream. Well made, the emulsion should keep indefinitely, and should be diluted only as wanted for use. Dilute this with 10 to 15 parts of water. The plants should not be left in this emulsion more than two or three minutes and should then be well washed in fresh water.

2. Fumigation with Hydrocyanic Acid Gas

Though dipping in an insecticide will undoubtedly kill most of the aphids, fumigation by means of hydrocyanic acid gas is much quicker, less work, and a more certain and complete remedy. It should always be remembered that it is a most poisonous gas and should be used with caution.

A. Apparatus

The only apparatus needed is a fair-sized air-tight box. This box is 2x2x2½ feet, without a bottom, made of two thicknesses of matched wainscoting with building paper between; the cover closes upon a rabbet the depth of the thickness of the material and lined with felt; a small door about 6x6 inches is placed at the lower corner and similarly fitted so as to close on felt; four or five frames covered with wire netting rest upon the cleats, the lower one being about three or four inches above the ground and extend-

ing to the small door, and the rest of the trays extending clear across the box, being about five inches apart. Such a box will hold from 1,500 to 2,000 loose plants, placing only one layer on a frame, which permits a quick and thorough diffusion of the gas.

The only other apparatus necessary is a coffee cup in which to generate the gas.

B. Strength of Gas and Length of Fumigation

Numerous experiments have been made to determine the effect, both upon the aphids and the plants, of different strengths of this gas and various lengths of fumigation. Though these experiments are not absolutely conclusive, they seem to warrant the conclusion that in a tight box or room, approximately cubical in shape, gas at the strength of three-tenths of a gram potassium cyanide per cubic foot of space, fumigated for ten minutes, or two-tenths of a gram for 15 or 20 minutes, will kill the aphids without injury to the plants. These strengths may safely be recommended for use.

C. Procedure

The process of fumigation is essentially the same as that employed in fumigating nursery trees. Earth is firmly packed around the open bottom of the box. The plants, which should be well cleaned of earth, are laid on the trays, the bundles being cut open and thoroughly loosened. The lid of the box is then closed and fastened. A coffee cup or similar vessel is now placed in the lower corner of the box by the door and into it is first dropped a vial containing a proper amount of the cyanide in solution. A vial containing the sulphuric acid is then dropped in and the door quickly closed. Of course the vials are dropped in with the mouths down, and if they be long and narrow the contents will drain out gradually, avoiding a puff of the gas by too rapid generation. The box is kept closed for ten minutes, or as long as desired. Both doors are then thrown open and the trays lifted out so that the plants can be thoroughly aired.

The cyanide solution should be secured from a druggist, put up in homeopathic vials, one dose in each vial. The solution consists of 100 grams 98 per cent potassium cyanide dissolved in water to make c.c. solution. The amount necessary for each dose is easily computed; multiplying the cubic contents of the box by four-tenths will give the number of cubic centimeters of the solution to be used (this giving a strength of two-tenths gram potassium cyanide per cubic foot). Use an equal amount of sulphuric acid, which can be readily measured into empty vials. Thus for the box described, 2x2x2½ feet, or 10 cubic feet, 4 c.c. of the solution, or a two-drachm vial half full, and an equal amount of sulphuric acid (best grade commercial, 1.85 sp. gr.) would be used for a strength of two-tenths gram potassium cyanide per cubic foot, or the same vial three-quarters full for a strength of three-tenth gram potassium cyanide per cubic foot.

D. Caution

Cyanide of potassium is as deadly a poison as is known, and is sure and certain death if taken internally—no antidote being known. Each vial should therefore be plainly labeled in red, with a druggist's poison label.

The vials should be locked up, and after use should be carefully washed. The residue left after the generation should be washed from the vessel and buried so that it cannot be found by animals. The sulphuric acid should also be labeled and carefully handled, as it will destroy clothing and other things with which it comes in contact.

3. Prevention of Introduction of Aphis After Planting

With uninfested plants planted on clean land there exists no chance for injury from the root lice except by the winged form being introduced from neighboring beds. Thus in many cases it will be necessary to plow under deeply the old infested beds some time before the winged lice appear in order to prevent their spread to the ones newly planted.

B. Remedial Measures

Summary of Treatment

As a conclusion from the above, the following procedure seems to be the best method of controlling the strawberry root louse. Plant only absolutely clean plants, requiring a certificate of freedom from insect pests, if purchased; plant only on ground which has not recently been in strawberries; plow under all old infested beds before May 1st, or locate new beds as far from them as possible; if the use of infested plants is unavoidable, disinfect them carefully by dipping or fumigation, and do not plant them on land previously in strawberries, corn, or melons. These measures are all preventive; no successful remedial measures are known.

Literature

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Strawberry Root Weevil

Otiorhynchus ovatus Linn.

A. L. Lovett

The strawberry root weevil is pre-eminently the most serious of the insect pests of the strawberry in the Pacific Northwest. Fortunately, it appears as yet rather restricted in its range, occurring in abundance only through Northern and Eastern Oregon and Washington and in British Columbia, Canada. At present it bids fair to render the berry business unprofitable in some sections unless the growers, through a common interest, adopt more stringent methods of handling the industry.

The strawberry root weevil was undoubtedly introduced from Europe. The first report we have of it in this country is in Massachusetts in 1852. Since that time it has spread steadily westward and also northward, being reported successively from Michigan, Canada, Wyoming, New Mexico, Minnesota, Montana and Oregon and finally Washington.

When we consider the fact that this insect cannot fly, but must depend almost entirely on outside agencies for transportation, its spread seems fairly rapid.

Common Name

There are a variety of common names in current use for this pest. In the earlier literature of this country it received the name of *graveyard bug*, in some of the later literature it is referred to as the *pitchy legged Otiorhynchus*. Canadian entomologists refer to it as the *sleepy weevil*. The name commonly adopted has been the *strawberry crown girdler*, and in Oregon it is termed the *strawberry grub*. If a common name is to be descriptive and individual, the author would suggest the name *strawberry root weevil*. In my observations, the habit of girdling the crown is rather exceptional, the majority of the grubs feeding on the small, fibrous, lateral rootlets. When they do attack the crown the habit of burrowing straight through it is just as common as that of feeding around it. So, while realizing that a mass of common names tends but to confuse, the author feels justified in adopting the name *strawberry root weevil*.

Fig. 1. Strawberry Leaves Showing Effect of Feeding of the Adult Strawberry Root Weevil. (Original.)

Destructiveness

The strawberry root weevil is a pest both as a beetle and as a grub. The beetles feed on the foliage, stripping and

ragging it in a characteristic manner (Fig. 1). The grubs feed on the entire root system of the strawberry. The smaller grubs are usually found feeding on the fibrous rootlets, often devouring them entirely or barking them so that they die. A seriously infested plant may be kicked out with the foot or easily pulled up, often with the fibrous root system eaten away. Undoubtedly a portion of the grubs feed closely about the main tap root and their feeding there will sometimes girdle the crown. The larger grubs are often found buried in the tap root, and this food seems to give them a more pinkish cast, giving rise to a common belief that two species of larvae are present.

These beetles may be present in a patch for years and but little injury result from their attacks. In the weevil districts, under normal conditions, an infested patch will show a few sickly hills the first season, small patches here and there dead the second season, and the patch rendered worthless the next spring. This affords one full crop in the usual system of culture. A condition that is becoming quite common, however, is for the patch to be materially weakened the first season; and the second season, or the first expected to yield a full crop, the patch is absolutely worthless. Two factors render this condition possible. The soil is often already infested with the grubs even though strawberries have not been grown on the ground previously, and again the beetles from older infested beds all about tend to concentrate on the new patch.

Food Plants

While the strawberry root weevil shows a decided preference for the strawberry, it is by no means confined to this food plant. The following list is compiled from reported food plants:

Food Plant List for Adult Beetles of O. ovatus

Strawberry, raspberry, loganberry blackberry, rose and other shrubbery, borage, currant, muskmelon, sorrel (*Rumex acetosella*), wild rose, balsam root (*Balsamorrhiza sagatata*), potatoes, wild buckwheat, hemlock, pumpkin, wheat, corn, cabbage, cherry, red clover, apple (fruit), dahlias (bloom), orchid (fruit).

Fig. 2. Strawberry Weevils. Upper figures, adults of *O. rugifons*. Lower figures, adults of *O. ovatus*.

Food Plant List of Larvae—Root System

Strawberry, raspberry, blackberry, loganberry, wild strawberry, sorrel (*Rumex acetosella*), grass (*poa cerotine*), timothy, bluegrass, potentilla glandulosa, June grass, white clover, hemlock, cabbage (?).

Description

The adult weevil is a snout beetle, 6 mm., or nearly one-fourth of an inch in length. The color of the insect varies from a dull reddish-brown when freshly emerged to almost pitch black; the surface is roughly pitted and slightly shiny. The beak is short, broad and emarginate at the tip; there is a distinct puncture between the eyes. The antennae are elbowed and consist of nine segments.

The Egg

Very small, milky white, smooth and translucent at first but later yellowish-brown and rough.

Larvae

Pinkish or white and when full grown three-eighths inch long. On each segment is a row of reddish-brown hairs.

Pupa

Pure white at first but turning to dark brown finally. Segments of head, thorax

and abdomen have a transverse row of reddish-brown hairs.

Seasonal History

The strawberry root weevil is single brooded. The adult beetles may remain alive and active for more than a year. There are then for a short period of time two generations of beetles present. This complicates matters somewhat and affords a reasonable chance for error in checking up the life history. These beetles are busily engaged in feeding on the foliage of the strawberry and other host, ragging and stripping it. The insects pass the winter in both the adult and grub stage. The beetles hibernate in all conceivable sorts of places. Many of them become restless in early September and begin seeking a place for hibernation. Very often in this search they enter dwellings and prove a source of no little worry to the housewife by crawling over and under everything and dropping from the walls and ceiling into dishes and vessels. Many of them remain in the field, hibernating in the soil up close about the crown of their host, or crowded down into the sheaths about the central whorl of the crown.

They have been found in bundles of shingles, in bundles of bedding and in crates of nursery stock and other transportable material. This may account in a large measure for their spread to new localities. The grubs pass the winter in the soil about the roots of their hosts. A portion of them are mature in late fall, and even form in the soil what will constitute the pupa cell. The majority of the grubs pass the winter as nearly mature larvae, feeding to a limited extent on their host. A very few grubs occur during the winter as only half-grown larvae, and these naturally prolong the period of pupation and emergence of the adult weevils the following spring.

The first pupae occur in early May. During late May and June the majority of the new generation of beetles emerge. Even earlier than this the overwintering brood of beetles assume a traveling habit and crawl for a considerable distance. The new generation of beetles also travel, and during May the housewife is again worried by the presence of this beetle in the house. About two weeks after the new generation of beetles commence to emerge the first eggs are found. The majority of these eggs are deposited promiscuously through the soil from one-half to three inches below the surface and extending from close about the crown out in a radius as great as that covered by the foliage of the plant. Later in the season as the soil dries out, eggs are deposited about the central growing whorl of the crown, usually well down among the sheaths. They are also found in cracks and crevices frequented by the beetles and in tunnels that sometimes occur about the base of the plants. These tunnels are mentioned by Cooley* as formed by the beetles, but it is my belief that they are formed by earth worms and are simply appropriated by the beetles. The largest number of eggs deposited by a female in confinement was 43. The beetles themselves feed at night and during the day crowd down in dark sheltered places. They will often be found in numbers under a clod, in a crevice or crack in the soil, in the tunnels mentioned above, or crowded down about the crown of the plant itself.

The eggs begin hatching in about nine days, and unlike the egg of many insects, will hatch even in dry soil. By far the majority of the eggs are deposited during June. The young grubs are fairly hardy and active. They can live in dry soil for 36 hours without food, and can travel over loose dry soil at the rate of eight inches in 16 hours.

Fig. 3 Adult Larva and Pupa of Large Weevil found at Milton, Oregon.

*Cooley, R. A., Montana Experiment Station Bulletin 55.

Control Measures

One Crop Rotation

Prof. James Fletcher, late Entomologist of Canada, recommends what he terms the one-crop plan.

"This consists of setting out new beds of strawberries in the spring, cultivating these for the first summer, taking one large crop of berries the next spring, and then ploughing the plants up as soon as the crop is off. In the meantime a new bed will have been set out from the runners of the bearing bed early in the spring before the fruit ripened. This plan of strawberry culture not only prevents loss from the attacks of such enemies as the white grubs and the above mentioned weevils [*O. ovatus*, *O. sulcatus*], but is also a paying operation, giving better returns from the higher price secured with the large fruit thus grown than from a large crop of small berries."

Trapping

The insects feed at night and tend to seek shelter in darkened, cool places through the day. Various traps may be used to attract them. Professor Fletcher* recommends common flower pots filled with hay, inverted and raised slightly from the ground. If these are placed about the field the beetles will crawl inside for protection and may be shaken out into a bucket of water having a thin surface-coating of oil.

Distribution

Irrigation ditches are a ready means of distribution. Where a company ditch is used by a community, beetles from an infested patch up stream will crawl into the ditch and be washed down and into new fields below. To avoid this means of infestation the use of private wells and a pumping station seems the only solution, and this is not always possible or practical.

New plants should be obtained, so far as possible, from uninfested districts. When obtained from a suspicious neighborhood the plants and containers should be examined carefully for adult beetles.

* Fletcher, James. Canada Experiment Farms Report, 1905, p. 186.

Natural Enemies

The natural enemies have not been given the study they should. An immature Gamasid mite was discovered feeding on the eggs at Gresham, Oregon.

Domestic fowls feed on the larvae and pupae when allowed to follow the plow.

Carabid beetles and their larvae are often found about the hills.

At least two species of spiders attack the adult beetles. These spiders construct their webs in the foliage of the strawberry plant. The remains of as high as 18 adult weevils were found in a single web.

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Allied Species of Weevils Found on Strawberry

Several very closely allied weevils have been found infesting the strawberry in

the Northwest. *Otiorhynchus sulcatus* occurs about everywhere that *O. ovatus* is found. In Oregon a larger species also occurs (Fig. 3), which in the Milton-Freewater district is doing considerable damage in a few of the strawberry fields. In the vicinity of Oswego, Oregon, a third species, *Otiorhynchus rugifrons* (See Fig. 2), bids fair to outclass the *Otiorhynchus ovatus* in its ability to multiply and to destroy berry fields.

Otiorhynchus sulcatus is not considered of especial importance by the growers. It apparently does not spread rapidly nor multiply fast enough to injure a field to a noticeable extent. The larger weevil has a variety of host plants. It is capable of injuring a strawberry patch by the third season or the fourth spring from planting. No especial study of these species has so far been made. It would seem that the same remedial measures would apply as for *ovatus*.

STRAWBERRY THRIPS. See *Grain Thrips*, under *Strawberry*.

Strawberry Weevil

Anthonomus signatus Say

It is a curious fact, for which we have no explanation thus far, that this insect is not equally abundant in the same locality more than two or three years in succession, and that after a period of abundance there may be an equal period during which nothing will be seen of it. Meanwhile some other locality may be suffering an invasion. Thus far we have no way of predicting at the beginning of a season whether or not injury will be caused by the beetle.

The strawberry weevil has been reported from Virginia, Maryland, District of Columbia and New Jersey.

Life History, Habits and Injury

The adult beetle makes its appearance in the strawberry fields as soon as the season opens and growth begins. The adult is less than an eighth of an inch in length, black in color, with bands of white scales, often with a reddish tinge through the black ground, and with a darker, bare spot on the side of each wing cover behind the middle.

This beetle hibernates in and under leaves and rubbish, and mating takes place as soon as the insects have fed. To feed, before the blossoms open, the weevil punctures a forming bud, usually selecting one that is well advanced, and thus gets at the immature pollen.

Eggs are laid in the buds of staminate varieties only. The beetle first punctures the bud with its beak as in feeding, then turns, lays an egg into the puncture, turns again, and with the beak forces the egg into the bud, while the plant tissue closes over the opening, leaving only a small discolored spot. Then the beetle, shifting its point of operation, crawls down the stem below the bud about one-quarter of an inch, and punctures this to such an extent that the tissue is broken, the circulation of sap arrested, and the further growth of the bud checked. After a day or two the bud wilts and droops, and in a few days usually falls to the ground.

As to the amount of injury, estimates vary. All growers agree that it is serious, and it is not unusual to see 50 per cent of the early buds cut.

Since the beetles feed very little upon exposed leaf tissue, spraying with internal poisons is likely to have little effect. However, Bordeaux has proven a fairly effective repellent. The mixture should be 4-4-50 formula.

The spraying should be done just before blossoming begins, and should be very thorough. Spraying while in bloom is objectionable because of the danger of preventing pollination by bees and other insects.

Another measure, sometimes resorted to with good effect, is to burn over the field just as soon as picking is done. The vines are mowed close, left to dry out a day or two, covered lightly with straw and then set afire, when the wind is right. This burns off all surface rubbish, the field is cultivated, and the plants make a new start.

It has been demonstrated that the plants can be kept free by covering the rows with muslin or other light fabric, put in place a week before the first buds are ready to open, and that this covering

promotes early ripening and better fruit. On a small patch only is this a practical measure. If applied, the covering need remain only until the first berries begin to color, because by that time the plants would be no longer attractive to the beetles.

A much better prospect for avoiding injury lies in the selection of varieties. Pistillate varieties are not subject to attack by the beetle, and it should be possible to secure a good pistillate variety to form the main bulk of the crop. This will need, as a pollenizer, a profusely flowering staminate variety, which may form every fifth row in the field, and the crop from which may be sacrificed to the beetles if they furnish flowers enough to pollenize the others.

Clean culture is highly important, and especially wild blackberry and raspberry in the vicinity of strawberry patches should be destroyed. Burn all rubbish and undergrowth around the edges of the fields when the ground is frozen in winter. Especially burn along and under fences and at the edges of woods, where the bulk of the wintering beetles are usually found.

During their long dormant stage, from mid-July to the following April, the insects are exposed to the attacks of small rodents, predatory insects, toads, frogs and lizards. It has been demonstrated in the case of the cotton boll weevil that few survive the winter unless shelter conditions are favorable.

Strawberry White Fly

Aleurodes packardi Morrill.

These white flies are very small, four-winged creatures, which, when at rest on the underside of the leaf, look like miniature moths. This impression is heightened by the white mealy powdering that covers the surface of the insect, and is responsible for one of its common names.

These flies occur at intervals throughout the summer from May to September, and lay their small, shortly stalked eggs on the undersides of the leaves. They hatch in about ten days into active yellowish larvae that very much resemble those of scale insects. As in the case of scales, this active stage is short, and in a short time the little creatures settle down and begin to suck the plant juices.

Then their resemblance to the scale insects becomes yet more marked for a time; they lose antennae and legs and are as much fixed to the plants as any scales. As they grow, this outside case or scale becomes fringed with waxy filaments, and honey-dew is excreted. When the insects are abundant this honey-dew dropping to leaves below may form a sticky varnished surface, upon which a black soot fungus develops.

As a result the foliage loses vitality and dries up or decays, seriously injuring or destroying the plants, especially if they be young or small.

The insects are rarely abundant enough to do severe injury on large plots, and it is only in droughty periods that they seem to become dangerous.

Remedial Measures

In the active larval stage this white fly succumbs readily to any of the contact insecticides at moderate strength, and the adult is not much more resistant, though this is harder to reach, because it flies readily if not very strongly. As against the nymphs or scale-like stages, kerosene emulsion diluted with 12 parts of water seems to be most effective; but it must be applied with a bent nozzle so as to hit the underside of the foliage. If adults are flying when the application is made, a fine spray is desirable, for this, if applied with sufficient force, will fill the air above and around the plants with a fine mist that will hit and disable many of the insects on the wing. Whale-oil soap suds, one pound in six gallons of water, has also been used with good effect in the same way.

A badly infested patch should never be used as a source for plants to make a new bed, unless these plants are first fumigated with hydrocyanic acid gas.

J. B. Smith,

New Jersey Experiment Station Bulletin 225.

Tarnished Plant Bug

Lygus pratensis Linn.
(Family *Capsidae*)

General Appearance

The mature bug varies from pale green to grayish-brown, marked with yellow, black and red. The legs are pale brown or yellow with dark rings. The young bugs are lighter in color than the adults, without pronounced markings. All forms are exceedingly common and very active.

Life History

Hibernation is usually passed in the adult stage, under any convenient shelter. In the early spring the females deposit their eggs directly upon the food plants. The young begin to feed as soon as hatched, and continue throughout their life history. This species is exceedingly prolific, and its ability to travel rapidly, and the large variety of food plants, make it a constant menace.

Food Plants

This bug feeds on almost every kind of plant. It is especially abundant in grain or hay fields. All vegetable gardens afford a ready supply of food. It is often destructive to apple, pear and strawberry.

Control

Because of its omnivorous habits and wide spread it seldom becomes a serious pest of any one crop. For the same reasons, control measures are most difficult. The presence of the insect need cause no alarm unless it is concentrating its attacks to a damaging degree upon cultivated crops. In such cases contact insecticides, such as emulsions, soap washes, tobacco sprays, resin washes, etc., may be used with deadly effect. These insecticides should be applied early in the morning and great care taken that they are not strong enough to injure the foliage of tender plants.

Clean culture serves to rid them from the fields before planting and to lessen the attacks the coming year.

E. O. Essig

Weevil. See *Strawberry Root Weevil* and *Strawberry Weevil*.

White Fly. See *Strawberry White Fly*.

White Grubs, May Beetles or June Bugs

J. B. Smith.

*White grubs occur in strawberry fields, sometimes in troublesome numbers, but rarely two seasons in succession, and then it is only the young fields that are troubled.

Life History

White grubs are larvae of "May beetles,' or "June bugs," the clumsy brown beetles about an inch long, that fly to light and often into houses in late May and early June. These beetles lay their eggs in grass lands or land covered with vegetation to form a sod of some kind. Their growth is slow and it requires three years to complete the transformation. During this time they have remained underground, feeding upon roots, emerging as adults in May or June of the third season.

There are several species of May beetles, and there is probably some difference in their life cycle, but, in a general way, that above given is correct.

It will be readily seen that after a plot is in sod for three years the ground will be full of grubs in all stages of growth, and that every year thereafter the number of full-grown larvae is likely to increase.

When such a sod is turned under and another crop is planted, that crop almost inevitably suffers, for the insects, deprived of the mat of roots upon which they have been feeding, concentrate on the small number of plants, and the result is fatal.

Remedial Measures

We have no satisfactory insecticides to reach underground insects. They have their natural enemies among the vertebrates—birds, moles and the like—as well as insect parasites and fungous diseases, but these do not keep down the insects to harmless numbers.

It is in farm practice that our hope of control lies. In the first place keep land in grass or fallow as short a time as possible consistent with the desired rotation and never allow a field to become badly

*New Jersey Bulletin 225

overrun by weeds early in the season if it can be avoided.

In case it is necessary to use an old sod, plow in early fall. Although the white grubs change to beetles in September they are at that time soft and helpless, and if turned up to the surface they are unable to find their way back and will perish. If still in the pupal stage they will perish without being able to transform. Plowing in mid-September will be best for this purpose, and, if desired, a cover crop can be put on. In the more northern counties early September may be better, as it will give more chance for a cover crop to take hold. This process will kill the brood ready to transform, but will not kill the younger grubs yet in the ground.

To reach these, turn hogs, or chickens, or turkeys, or all three into the newly plowed field, and they will get the great majority of all the grubs in the field. Indeed, in an old sod, if a few shallow furrows be run through it and hogs turned in, they will from the start thus given them root the entire field, and get all but a small percentage of the grubs. In localities where white grubs are known to be troublesome, every sod field to be put into strawberries should be treated in this way to avoid injury.

Where white grubs are actually in a strawberry bed, there is nothing to do but dig them out wherever a plant shows injury. In such a case it is well also to let the field run moderately to weeds to distribute the feeding, while not enough to attract beetles to lay eggs.

(See *Potato Pests* for illustration.)

Wire Worms

Elateridae.

See *Potato Pests*.

Summer Pruning. See *Pruning*, under *Apple*.

Sutton Apple for Massachusetts. See *Massachusetts*.

Sweet Potatoes

The sweet potato is related to the morning glory, and is known botanically as *Ipomaea batatas*. The plant is not known in a truly wild state, and it is not known with certainty where it originated; but A. de Condolle thinks that it is in all probability of American origin, where it has been cultivated from prehistoric times by the aborigines for the sake of its nutritious, sweetish tuberous roots, which as an article of diet are greatly prized in all parts of Europe and America. It is a climbing perennial with entire or palmately lobed leaves, variable in shape, borne on slender twining stems, and flowers in loose clusters. The edible portion of the root dilates into a large club shape, or cone shaped mass filled with starch and other nutritious elements. While in its original state it was a perennial, it is usually cultivated as an annual.

How Propagated

It is easily cultivated in the southern part of the United States, where the winters are mild, but in the Central or Northern states it is propagated by planting the tubers in a hotbed early in the spring, and when the sprouts are two to four inches long severing them from the tuber, leaving the tuber to produce other sprouts, and planting the sprouts in ridges made for the purpose, or in hills. These plants are set much like cabbage plants, except that the ground must be prepared in a different way by ridging. The soil best adapted is a sandy loam, not too rich. If too rich the potato will be large but more subject to the atacks of insects and not so well flavored. The yam is a variety of the same species, but not so popular. In the autumn, when the potatoes are dug, they may be stored in a cool, dry place for winter.

We quote from W. H. Beattie as follows:

"Toward the northern part of the area over which sweet potatoes are grown it is necessary to start the plants in a hotbed in order that the length of season may be sufficient to mature the crop. The roots that are too small for marketing are used for seed, and these are bedded close together in the hotbed and covered with about two inches of sand or fine soil, such as leaf mold. The seed should be bedded about five or six weeks before it will be safe to set the plants in the open ground,

which is usually about May 15 or May 20. Toward the last the hotbed should be ventilated very freely in order to harden off the plants.

"The ridges for planting sweet potatoes should be three to five feet apart and the plants about 14 inches apart in the row. Cultivate sufficiently to keep the surface soil loose and free from weeds, and the vines will soon cover the ground, after which no cultivation will be necessary. In the warmer parts of the country the seed is not bedded, but is cut in small pieces and planted in the ridges instead of plants. After the plants come up and begin to make vines freely, pieces of the vines are removed and used as cuttings for planting additional areas, the cuttings taking root and growing the same as plants grown from seed. In this manner three and four plantings are made, the last being as late as the middle of July. If a rainy spell be selected for making and planting the cuttings, very few will fail to grow, and an excellent crop may be produced.

"To the north sweet potatoes are dug as soon as the vines are nipped by frost. In the South the potatoes are allowed to remain in the ground until a convenient time for handling them, and in Florida or Texas they are frequently left until required for use. Sweet potatoes should be dug on a bright, drying day when the soil is not too wet. On a small scale they may be dug with a spading fork, and great care should be taken that the roots do not become bruised or injured in the process of handling. It is desirable that the roots should lie exposed for two or three hours to dry thoroughly, after which they may be placed in a warm, well-ventilated room to cure for several days. The proper temperature for curing sweet potatoes is from 80° to 90° F. and 45° or 55° F. afterwards."

GRANVILLE LOWTHER

SWEET POTATO DISEASES

Bin or Soft Rot

Rhizopus nigricans Ehr.

Is encountered by sweet potato growers. The fungus producing it may be present in the plant bed and apparent as dark spots or rotted tips on the plants at setting. All such plants ought to be discarded if avoidance of disease is sought.

Avoid bruising potatoes, and store in dry place with good ventilation, at temperature of about 60 degrees. The temperature in potato houses or banks should not go below 50 degrees F. at any time.

Black Rot

Sphaeronema fimbriatum (Ell. & Hals.) Sacc.

The black rot of the sweet potato is one of the most destructive diseases of this host, and it is known to occur from New Jersey southward practically throughout the Atlantic coast region. The distribution of the fungus, however, is not completely known. The disease may appear in the seed bed, resulting from the use of infected seed roots. The disease upon the seedlings is known as black shank, due to the black spots or discolorations on the roots and young stems. The commercial root may be infested either as a result of planting diseased slips, or the infection may be due to the presence of the fungus in the soil. Upon the full-grown root the disease appears in the form of dark patches or decayed spots, which, upon careful examination, and especially upon removal of the skin, will appear green. These spots vary in size from minute flecks to extensive areas involving practically the whole root. When the roots are diseased there is no appearance of the vegetative parts which suggests the presence of the parasite.

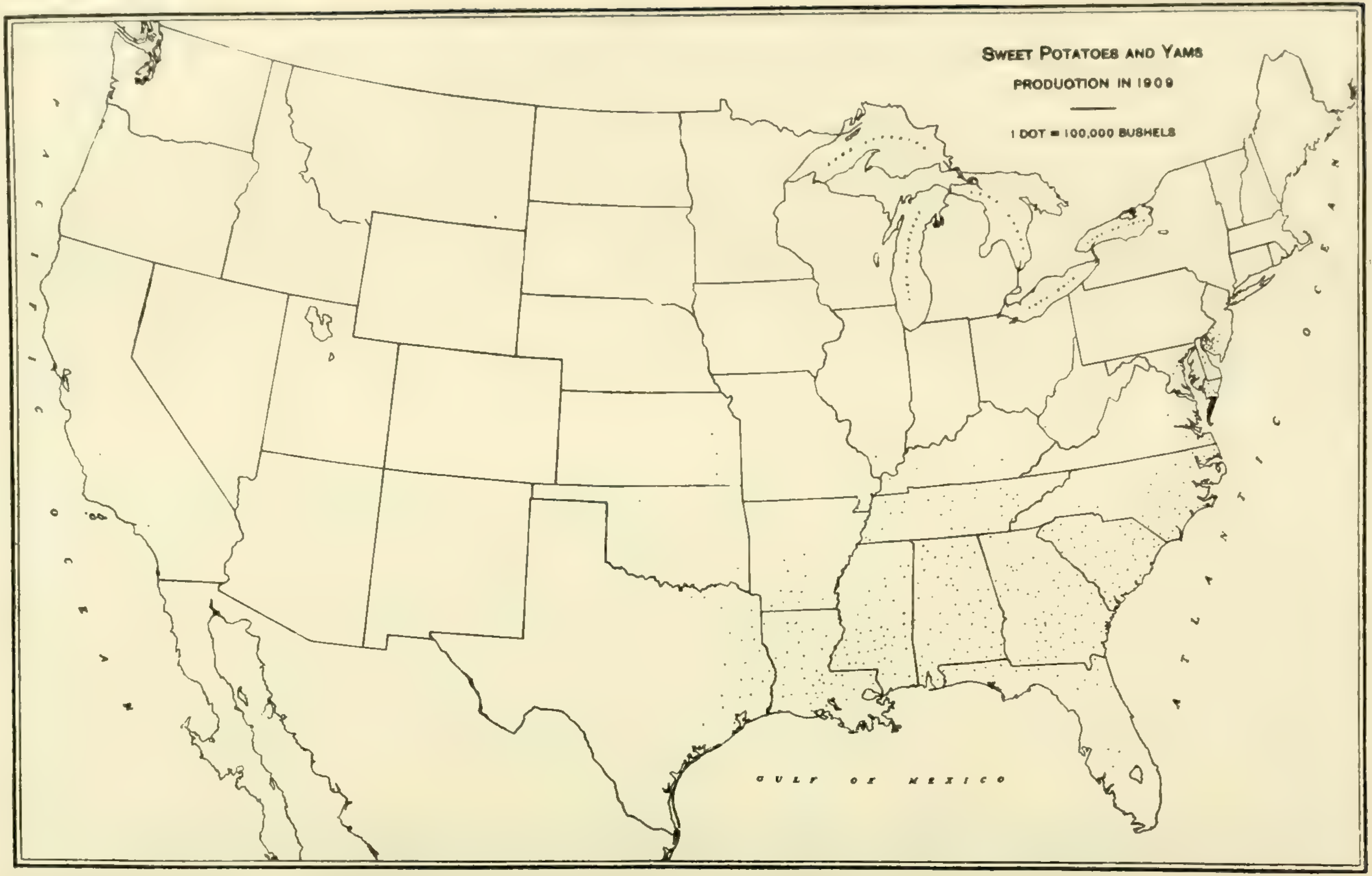
Control

Seed roots for planting purposes should be carefully selected and no slips should be taken from plants in the seed beds showing disease. Rotation of crops in necessary to rid fields of this fungus. Apparently no experiments of interest have been made to determine the possibility of preventing the spread of the fungus in stored roots. Nevertheless, any condition favoring the accumulation of moisture would be favorable to the organism.

Duggar. Fungous Diseases of Plants.

Thirteenth Census of the United States 1910

Department of Commerce, Bureau of the Census



Map Showing Distribution of the Sweet Potato and Yam Industry in the United States and the Relative Production in the Several Sections.

Black Shank. See *Black Rot,* this section.

Dry Rot

Phoma batatae Ell. & Hals.

Occurs on underground parts, causing wrinkled and pimply appearance. Inside of potatoes turn brown and become dry and powdery. Rotate crops. Gather and burn diseased potatoes. Plant clean stock.

Soil Rot

Acrocystis batatas Ell. & Hals.

Soil rot is a serious disease of the sweet potato for which the following treatment has proved successful.

Bake a mixture of six parts earth to one part flowers of sulphur and drop in handfuls where the plants are to be set and set the plants through this mixture.

Literature

New Jersey Experiment Station Bulletin 126.

Soft Rot. See *Bin Rot,* this section.

Stem Rot or Yellow Rot

Nectria ipomoeae Hals.

Appears as dark streak on stems and upper ends of potatoes at or near surface of ground, causing vines to die and extending downward into roots, causing potatoes to rot.

It is necessary to have clean seed, the hotbed surrounding must be free from the organisms, and the plants must be set in soil which is free from disease.

Rotation so as to bring sweet potatoes onto the same soil not oftener than three years is advised.

SWEET POTATO PESTS

Cutworms

*Under some conditions and in some seasons cutworms do considerable mischief in sweet potato fields, and their injury is always clean-cut and readily recognizable. The plants are cut off close to the surface and the heart is chewed out.

Remedial Measures

If by some misfortune a field is found infested after it is set with plants, the cutworms can be cleaned out by using poisoned bran. For some reason bran is very attractive to these insects, and they will take it in preference to even succulent plant-food. Mix one pound white arsenic or Paris green with fifty pounds of bran and five pounds of powdered sugar; add water enough to moisten thoroughly, so that it can be ladled out without dripping. The sugar will hold it together and a spoonful to a hill of plants will attract every cutworm in a field in two or three nights, absolutely cleaning them out. No one who has not tried this method carefully can realize how complete is the remedy.

The Gold Bugs or Tortoise Beetles

The leaves of the newly-set plants are apt to be eaten into irregularly, and sometimes altogether devoured before they get a fair start at growth; and even in the forcing bed such eating may appear to some extent. The authors of this injury are called "tortoise beetles" from their shape, which is a somewhat squared oval, very flat beneath, and not very convex above, or "gold bugs," from their beautiful color, some of them looking like drops of molten gold. There are four distinct species of these beetles — two-striped sweet potato beetle, golden tortoise beetle, black-legged tortoise beetle, and mottled tortoise beetle—but their habits are so much alike that, for convenience, they may first be considered together.

General Life History

The insects live through the winter in the adult or beetle stage in crevices, under bark, and in similar dry places wherever they can find shelter. They make their appearance in May, when warm weather has fairly set in, and feed on any Convolvulus plant that is available, favoring sweet potato in every instance. At first they favor the under side of the leaf, eating round or oval holes until the tissue is so much eaten that they take it as they can get it, and leave only the larger veins and leaf stalks. They continue feeding until after the middle of June, but usually disappear before the end of the month.

*New Jersey Experiment Station Bulletin 229.

The larvæ are decidedly flattened, more or less oval, with lateral spines or processes from the margins, and at the end of the body is a fork which, in some species, holds all the excrement voided during life, and sometimes the cast skins as well, often making a mass nearly as large as the larva itself.

Remedial Measures

The same measures suggested for poisoning the flea beetle will answer for these tortoise beetles as well. Dip the plants before they are set out in a mixture of one pound arsenate of lead in from six to ten gallons of water, to kill off the adult beetles as soon as they begin to feed. In the forcing bed, plants can be sprayed with the weaker mixture with good effect because, as the insects eat the entire leaf tissue, they will be poisoned whether they eat from the upper or under side. So, in the field, should the "peddlers" become numerous enough to be harmful, spraying may be resorted to with good effect, as these also eat the entire leaf tissue.

Sweet Potato Flea Beetle

Chaetocnema confinis Lec.

This is a small, bronzed, or brassy-brown shining beetle, about one-sixteenth of an inch in length, very active, somewhat chunky, with deeply ridged or striated wing covers. All these characters, except the general shape and bronze color, requiring a magnifying glass to make out clearly.

These beetles live through the winter in rubbish, under logs, stones or among masses of leaves and other vegetation.

Early in May, when the weather becomes really warm, these beetles leave their winter quarters and seek food. Their eating is peculiar in character and easily recognized. On either upper or under side they chew out narrow grooves or channels, at first close to and parallel with some of the principal veins; later, when the leaf has been pretty well eaten into, the channels may run any way. Early in June the beetles begin to decrease in number, and, as the bindweeds are by this time growing vigorously, the tendency on their part is to forsake the cultivated for the wild plants.

Remedial Measures

These may be direct or indirect, and may consist of applications of an arsenical poison, or a modification of cultural methods. The simplest plan is to dip the plants, before setting, into a mixture of one pound arsenate of lead in ten gallons of water. Use a good grade arsenate of lead, running 14 per cent or more of arsenic, or if a 12 per cent material is used, make it one pound in six gallons of water. Spraying will not answer the same purpose as dipping, because it is simply impossible to coat the leaves on both sides as thoroughly. But in the forcing bed the plants may be sprayed to good advantage should the insects at any time become sufficiently abundant to make it desirable.

The second method consists in delaying the setting until the latest possible moment, so that the beetles may be forced to the bindweeds and other natural food-plants before the sweet potato plants get into the field.

Sweet Potato Stem Borer

Omphisa anastomosalis Guen.

Frederick Maskew

The sweet potato stem borer is Oriental in origin, having been recorded as being more or less general throughout the Indo-Malayan region. So far it has not yet become established in this country.

There is but little hope of relief from the application of remedies in localities where this pest has become established. During the most vulnerable stage it works in secret, protected from interference by the tissues of the plant it has attacked. Those who by reason of experience in dealing with this pest are the most competent to advise, offer as the only practical course to pursue, a complete change of location. The work upon the mature potatoes is very insidious and not to be detected until the potatoes are cut open.

Sweet Potato Weevil

Cylas formicarius Tryon.

Cylas formicarius is a very widely distributed species, and a native probably of Cochin China. Compere has a record of finding it at Bombay and also at Calcutta in sweet potatoes offered for sale in the public markets at both of those places. It has also been reported from Madagascar, Southern United States, West Indies and Northern Australia; but not yet, so far, from the sweet potato fields or markets of this country.

It also occurs in the Hawaiian territory.

The beetle is somewhat ant-like in form. The color of the elytra (wing covers) and of the head and beak is bluish black; that of the pro-thorax is reddish-brown. The yellowish-white oval eggs are laid in small cavities eaten by the parent beetles near the stem end of the tuberous roots. The milk-white larvæ bore little tunnels through the roots in all directions, so that the vine dies; and frequently the entire potato is tunneled; these burrows become filled behind the larvæ with excrement. When about to assume the pupa state, the insect forms an oval cavity at the end of its burrow, whence it undergoes its transformation.

Tortoise Beetles. See *Gold Bugs*, this section.

Syrphus Flies

Syrphidae

Flower, Honey or Sweat Flies

Always among the plant lice are to be found greenish, flat, sticky-looking "worms" which are decidedly pointed at one end and do not have distinct head, eyes or legs. These so-called "worms" are the larvæ or maggots of flies belonging to the family *Syrphidae*, which are commonly called syrphid or flower-flies. The larvæ vary from the minutest first-hatched maggot to nearly an inch in length, according to the species to which they belong. They are usually light or dark green, but some may be brown, orange, very light or nearly black. Those feeding upon plant lice are green with a longitudinal darker green or brownish stripe on the dorsum. The mouth is situated at the small end and all of the food is obtained by puncturing the body walls of the lice and then sucking out the contents. This operation is easily observed in the field. The maggot firmly supports itself by the large posterior end, raises itself up and begins to blindly move its mouth end about in quest of food. If it touches a plant louse it immediately lifts it into the air and sucks it dry. This is very rapidly repeated, with very disastrous results to the lice. When the larva is full grown it seeks some sheltered spot in which to pupate (transform into the adult fly). This it may do on the stems or upon the surface of a leaf. The puparium is a long, roundish, or oval, brown body, showing no signs of life. The adult fly removes one end of the case to escape. The adults are usually dark with transverse yellow bands across the abdomen. They are very swift fliers and are often mistaken for bees. They are common around flowers, feeding upon the nectar and from this habit get the names "flower or honey flies." On hot days they are sometimes very numerous and are called "sweat flies" in the Eastern states. They deposit their eggs singly upon leaves and twigs which are infested with plant lice and these give rise to the green larvæ.

While these insects do much to prevent the spread of the plant lice, they are in turn preyed upon by other insects. Ants, which foster and protect the plant lice, kill and carry off the larvæ in large numbers and greatly reduce their efficiency. Internal parasites also prey upon them.

There are three species which are doing good work in keeping down plant lice; a very large species, *Lasiophthicus pyrastri* Linn., the American syrphid, *Syrphus americanus* Wied., and the small species *Allograpta obliqua* Say.

Tennessee

Tennessee has an area of 42,050 square miles.

On the east a part of the Appalachian range extends through the state, rising to a height of 6,600 feet, with many coves and beautiful valleys adapted to fruits and vegetables. Adjoining this section on the west is what is called the Valley of East Tennessee, a beautiful section lying between the Unaka mountains on the southeast and the Cumberland mountains on the northwest. This valley is undulating, and viewed from the higher elevations looks like the waters of the ocean arrested in their movement. It is an extension of the Shenandoah valley of Virginia. Next, going westward, is what is called the Cumberland tableland, rising 2,000 feet above the sea. Next to this is a portion of uneven surface extending from the western edge of the Cumberland tablelands to the Tennessee river. In the center of this section is a basin or depression called the Central basin, probably once the bed of a lake, which is now the richest body of farming land in the state of Tennessee. It is on an average 300 feet lower than the lands around it, and contains 5,450 square miles. West Tennessee is an undulating plain stretching toward the Mississippi river.

The great drainage systems of the state are the Mississippi river, the Tennessee and the Cumberland rivers. The average rainfall is 50 inches, and from the lower elevations on the Mississippi to the mountain lands, 6,000 feet higher, there is a marked difference in climate. It is said that on the mountains the climate is about that of Montreal, while in the Mississippi valley near the river semi-tropical fruits may be grown.

On account of the many geological formations the soils of Tennessee are perhaps more varied than those of any other state in the Union. One of the proofs that Tennessee is well adapted to horticulture is that all kinds of wild fruits and nuts, such as blackberries, raspberries, strawberries, grapes, gooseberries, dewberries, June berries, cherries, pawpaws, persimmons, huckleberries, crabapples, walnuts, chestnuts, pecans, hazlenuts, butternuts, and other fruits and nuts grow there. All classes of fruits commercially grown in the northern climates are grown in Tennessee.

GRANVILLE LOWTHER

Production of Fruits in Tennessee

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms.

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	.....	12,539	12,944	13,895,493	$923,613
Strawberries	6,046	10,761	11,548	12,339,584	835,739
Blackberries and dewberries	3,884	1,514	733	1,316,100	65,476
Raspberries and loganberries	830	253	471	222,331	20,931
Currants	52	2	12	3,726	261
Gooseberries	141	9	114	13,740	1,205
Other berries	1	(1)	66	12	I

1 Reported in small fractions.

Strawberries are by far the most important of the small fruits raised in Tennessee, with blackberries and dewberries ranking next. The total acreage of small fruits in 1909 was 12,539 and in 1899, 12,944, a decrease of 3.1 per cent. The production in 1909 was 13,895,000 quarts, as compared with 15,200,000 in 1899, and the value was $924,000 in 1909, as compared with $593,000 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In com-

paring one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 6,485,000 bushels, valued at $3,459,000. Apples contributed nearly three-fourths of this quantity, peaches and nectarines most of the remainder. The production of grapes in 1909 amounted to 1,979,480 pounds, valued at $85,423; that of nuts to 783,570 pounds, valued at $14,041, and tropical fruits produced in 1909 were valued at $4,127.

The production of all orchard fruits together in 1909 was 15.8 per cent more than that in 1899, while the production of grapes decreased decidedly. The value of orchard fruits increased from $1,480,000 in 1899 to $3,459,000 in 1909, and that of grapes decreased from $120,199 in 1899 to $85,423 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total		8,959,070		3,734,080	6,484,550	$3,459,077	5,599,688
Apples	123,411	4,838,922	67,350	2,117,246	4,640,444	2,172,475	5,387,775
Peaches and nectarines	101,871	3,163,737	44,328	1,190,727	1,579,019	1,055,379	77,678
Pears	41,261	233,407	28,015	174,675	83,557	78,448	43,609
Plums and prunes	32,581	499,627	12,392	108,510	139,093	86,743	73,315
Cherries	30,997	201,830	16,742	128,406	36,303	60,294	11,688
Apricots	2,586	4,337	1,617	3,517	1,677	1,657	211
Quinces	5,764	17,159	3,227	10,785	4,421	4,045	(2)
Mulberries	8	51	3	214	36	36	(2)
Unclassified							[3] 5,412
Grapes	23,675	338,758	8,129	76,040	1,979,480	85,423	4,355,122
Nuts, total		[4] 24,926		[4] 7,404	[4] 783,570	[4] 14,041	659,660
Pecans	389	2,037	395	3,309	25,581	2,566	7,810
Black walnuts	1,289	18,225	300	3,536	708,627	9,194	(2)
Chestnuts	92	1,302	11	214	16,409	1,127	(2)
Hickory nuts	35	1,840	2	12	23,246	566	(2)
Unclassified							[3] 651,850
Tropical Fruits, total		[5] 2,703		[5] 889		[5] 4,127	
Figs	617	2,287	226	793	68,535	4,070	5,690

[1] Expressed in bushels for orchard fruits, and pounds for grapes, nuts and figs.

[2] Included with "unclassified."

[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."

[4] Includes Persian or English walnuts, almonds, Japanese chestnuts, Japanese walnuts, Spanish walnuts, white walnuts, Spanish chestnuts, chinquapins and hazelnuts.

[5] Includes oranges, lemons and Japanese persimmons.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule:

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider..	4,734	1.9	Gals.......	213,916	295,218
Vinegar	8,645	3.5	Gals	191,915	180,338
Wine and grape juice	1,903	0.8	Gals	16,576	28,567
Dried fruits	13,252	5.4	Lbs	857,903	2,533,810

Frost and Precipitation in Tennessee

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Clarksville	Oct. 20	April 3	Oct. 10	April 23	47.8
Byrdstown	Oct. 20	April 11	Sept. 13	April 24	52.1
Rogersville.	Oct. 22	April 15	Oct. 1	April 24	44.9
Elizabethton	Oct. 21	April 22	Sept. 30	May 4	45.2
Trenton.....	Oct. 20	Mar. 29	Sept. 30	April 4	50.0
Johnsonville	Oct. 13	Mar. 5	Sept. 22	April 17	47.5
Nashville	Oct. 24	Mar. 2	Oct. 8	May 14	48.5
Carthage	Oct. 23	Mar. 4	Oct. 3	April 10	50.0
Erasmus..	Oct. 11	Mar. 29	Sept. 21	May 21	59.8
Knoxville	Oct. 27	Mar. 3	Oct. 1	April 24	49.7
Newport	Oct. 30	Mar. 12	Oct. 15	April 24	43.6
Hohenwald	Oct. 5	Mar. 15	Sept. 13	April 23	53.3
Decatur	Oct. 24	Mar. 12	Oct. 15	April 24	57.9
Memphis	Oct. 28	Mar. 24	Oct. 2	Mar. 27	50.8
Bolivar...	Oct. 26	April 11	Oct. 18	April 10	46.6
Savannah	Nov. 1	Mar. 27	Oct. 19	April 10	51.8
Tullahoma	Oct. 16	April 18	Sept. 27	May 14	52.0
Chattanooga	Oct. 26	April 2	Sept. 30	May 14	51.6

Texas

Texas is the largest state in the Union, containing 265,780 square miles. Its greatest length is 825 miles and its extreme breadth is 740 miles. The general surface of the state of Texas is an undulating plain, similar in appearance to the lands of Oklahoma, Kansas, Nebraska and the Dakotas. There are mountains in the northwest, heavy timber in the east, and marshes along the Gulf.

The state in general has a warm dry climate, varying in water-fall from five inches per annum in the extreme southwest to 60 inches in the northeast.

Divisions of Texas

Prof. T. V. Munson has divided the area of Texas as follows: First, the Gulf coastal plain; second, the East Texas forest region; third, the Red River valley; fourth, the black waxy prairies; fifth, the brown chocolate plains; sixth, the Pecos valley; seventh, the Rio Grande valley.

The Gulf coastal plain extends from 50 to 75 miles inland from the Gulf of Mexico, and varies in altitude from a few feet, along a sandy beach, to 100 feet some distance from the shore. This surface in places is timbered with oak and pine, but is mostly a black sandy prairie well adapted to the growing of figs, peaches, strawberries and vegetables. Pears are grown in a limited degree, but our observation was that blight was so great an enemy to the pear that it is doubtful if it will succeed commercially. Oranges and lemons are grown successfully in a few sheltered places near the coast.

The second division, or the East Texas forest region, has an elevation of from 100 to 600 feet above the sea. Here the

rainfall is abundant and all kinds of fruits common to the north temperate zone may be grown, except the hardier varieties adapted to colder climates. This region is especially adapted to peaches, and John S. Kerr says that ninety per cent of all the peaches grown in the state are produced in this region.

The third section, or the Red River valley, for about 250 miles westward, has about the same soil, climate and forest conditions as Eastern Texas, although its southern bluffs, about five to ten miles wide, are practically free from forests. In this strip of territory the summer varieties of apples do well, and peaches seldom fail. In this belt have grown up flourishing towns like Texarkana, Sherman, Paris, Dennison and Gainesville. Along the Trinity and Brazos rivers, there are places where the soil, climate and physical conditions are similar to the 200-mile strip along the Red river which have developed such towns as Dallas, Fort Worth, Brazos and Waco.

The fourth section, the black, waxy prairie region of Texas, lies west of the East Texas forest region and extends westward about 150 miles. It does not include the coast region nor the Red river region, but is more nearly the center of the state. This region has an elevation of about 400 feet in the eastern part and 1,000 feet in the northwest. The rainfall varies from 50 inches in the east, to 30 inches in the west. The soil is a limestone base mixed with decayed vegetable matter, that makes it very rich and waxy. It is not well adapted to fruits, but grains, grasses, cotton and many vegetables are grown successfully.

The fifth section, the brown chocolate region, lies westward of the black land region, and is about 600 miles long, by 200 wide. It is a semi-arid region. Horticulture has not developed largely in this region and will not be profitable without irrigation. The same may be said of the Staked Plains region, except that this section has a higher elevation, less rainfall, and that irrigation is practiced on a somewhat larger scale, by means of water pumped from wells, either by engines or windmills. This region is partly underlaid with a gravel base through which the water percolates, and wells sunk to a depth of 10 to 30 feet will furnish a supply sufficient for the irrigation of orchards and gardens, and even field crops could be properly irrigated in this manner.

West of this is the Pecos valley, where irrigation is practiced on a larger scale, and there is considerable commercial fruit growing. West of the Pecos valley region is the dry plains region, extending from the Pecos to the Rio Grande. This is more particularly a stock region. Farming is not an important industry, except in a few places where the lands are irrigated, but sheep, goats and cattle are grown in great numbers. There are a few places where the rainfall is sufficient for certain kinds of crops.

In the seventh section there are varieties of conditions. The land in this section is, in considerable degree, covered with mesquite brush and the clearing will cost from $5 to $15 per acre. The dominant feature of this section is the Rio Grande valley. In the upper part of the valley, Vinifera grapes are grown under irrigation and put upon the market in commercial quantities in August and September. Further down the valley toward the Gulf, near Del Rio, Eagle Pass, Laredo and Brownsville, grapes of the European varieties ripen in June and July, and at that time have no competition in the markets of the cities of Texas.

There is a section in Southwestern Texas, extending from Laredo to San Antonio, in which it has been proved that grapes are of a very fine quality, are easily grown, and the market conditions are the very best.

The following fruits have been successfully grown in Texas:

Apricots

Apricots, not largely grown for commercial purposes, but succeeded wherever peaches succeed. There are native seedling trees in different parts of the state which seldom fail to bear and produce heavy crops.

Cherries

Cherries are not largely grown in Texas. Sour cherries do well in the Panhandle and Llano Estacado areas, but cherry culture is not generally successful, and sweet cherries are considered failures.

Pears

Pears are not largely grown in Texas on account of the ravages of blight. In Reeves county, Kendall county, and the Panhandle some pear orchards have been grown successfully. The Kieffer and Bartlett do well.

Prunes

Prunes are much the same in their adaptability to soil and climate as peaches and can be successfully grown in the eastern part of the state, also in the Llano and Estacado or Staked Plains country.

Pecans

Pecans grow wild in Texas, and that is the best reason to suppose they can be grown commercially. For ages the strips of timber along the streams have contained pecan trees, and the work of the farmer in preparing the land for cultivation was to get rid of his pecan trees, as he would of other timber. This he found a difficult task, for the pecan is tenacious of life where the conditions are favorable for its growth.

Apples

John S. Kerr, one of the oldest and most experienced orchardists in Texas, thinks apples may be grown much more extensively than is generally supposed. He says: "The success of small apple orchards has long been known in the following counties: Erith, Montague, Fannin, Grayson, Denton, Collin and Cooke. The Shinnery oak districts of Texas have proved to be valuable lands for apple culture, and many orchards are now being planted in those sections. In the western part of Texas, the Panhandle, and Llano Estacado territories, there are vast areas of level farming lands, dotted with orchards containing a considerable sprinkling of apple trees of assorted varieties. The Toyah and the Pecos valleys are producing some good apples.

In East Texas, the Red Astrachan, Red June, and Summer Queen and Yellow Horse do well. In the western portion, the Missouri Pippin probably leads in favor, quality and productiveness. Along with it, we find in successful production, the Ben Davis, Gano, Arkansas Black, Mammoth Black Twig, and Limber Twig.

Orange Culture

The great question in reference to successful orange culture in Texas, is that of protecting the trees from the cold of winter. Sometimes for several years the orange-growing districts of Texas will succeed without injury from frost, then a "norther" will sweep down upon them and kill their trees. How to overcome this difficulty has been the study of the orange growers. Much progress has been made by the selection of frost resistant varieties, grafting on hardy stocks, and the control of the sap. In the selection of varieties, the consensus of opinion now is that the *Citrus trifoliata*, a deciduous tree of Japanese origin, is the best adapted. Taking this as a stock on which to graft the Satsuma, gives the best results.

As to sap control, this is largely a matter of watering, cultivation and fertilization. Trees that are heavily watered late in the season, heavily fertilized and cultivated, make a very rapid growth, and the wood is tender in the winter. The tendency now is to push the growth during the early part of the season, and encourage dormancy during the latter part as the winter approaches.

Figs

The following is a report of N. E. Stout, Friendwood, Texas, on the gross receipts of his Magnolia fig and Satsuma orange orchards for four years. This state does not include several hundred dollars worth of cuttings and buds, used in the writer's home nursery. The report is as follows: "The fig orchard, consisting of 13½ acres, was planted in the spring of the following years: 1899, 4 acres; 1901, 1½ acres; 1903, 8 acres. The orange orchard, consisting of 6½ acres, was planted as follows: Two acres in 1902, four acres in 1903 and one-half

acre in 1904. Earlier than 1906, I had sold several hundred dollars worth of fruit. My 1905 fig crop sold for more than $700.

Figs sold in 1906........	$ 696.97	
Oranges sold in 1906....	445.91	
No buds or cuttings sold		
Total		$1,142.88
Figs sold in 1907........	$1,463.62	
Oranges sold in 1907....	2,895.74	
Fig cuttings sold in 1907	24.20	
Orange buds sold in 1907	25.15	
Total		4,408.91
Figs sold in 1908........	$ 963.52	
Oranges sold in 1908....	1,653.98	
Orange buds sold in 1908	30.00	
Total		2,647.50
Figs sold in 1909........	1,893.86	
Oranges sold in 1909....	6,363.79	
Orange buds sold in 1909	406.95	
Total		8,664.60
Grand total for four years.....		$16,863.69

N. E. Stout

Persimmons

The persimmon, as it was known to the pioneers of the Middle and Atlantic states, was not a good fruit. It was exceedingly sour and only late in autumn, when it was so thoroughly ripe as to be partly decayed, was it considered good for food. Yet there were so many varieties, and the fruit has been so improved by selection, that it is now found on sale in all the fruit stores of the South, and is relished by the majority of people. This fruit grows in nearly all parts of the state, in all varieties of soil, and with some profit. Professor T. V. Munson developed a new variety, called the "American Honey"; and certain Japanese varieties have been introduced which succeed well. J. E. Fitzgerald, now president of the State Horticultural Society of Texas, says: "When I set out my first fruit trees, I set out 500 apple trees and two persimmon trees. I now wish I could call back that planting. I would set out 500 persimmon trees and two apple trees."

The persimmon trees cannot stand root rot, but outside of that, they are as hardy as oak, and insects do not bother them.

Strawberries

The strawberry succeeds anywhere in Texas that any other fruit can be grown.

Blackberries

Blackberries grow wild in Eastern Texas as in the "Great Peach Belt," and have been transplanted into other parts, but as yet no varieties have been developed that succeed well along the Gulf coast.

Dewberries and raspberries are adapted to much the same conditions as the blackberry.

The mulberry succeeds almost anywhere in Texas that trees of any variety will grow. Granville Lowther

Production of Fruits in Texas

Small fruits: 1909 and 1899. Strawberries are by far the most important of the small fruits raised in Texas, with blackberries and dewberries ranking next. The total acreage of small fruits in 1909 was 5,053, and in 1899, 3,904, an increase of 29.4 per cent. The production in 1909 was 6,183,000 quarts, as compared with 5,209,000 quarts in 1899, and the value was $480,000 in 1909, as compared with $305,000 in 1899.

The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	....	5,053	3,904	6,182,742	$480,331
Strawberries	1,423	2,161	1,361	4,207,056	334,651
Blackberries and dewberries	5,459	2,773	2,394	1,868,119	138,557
Raspberries and loganberries	224	104	103	97,652	6,302
Currants	49	6	4	4,873	496
Gooseberries	11	9	1	5,042	325
Other berries	....	....	41	....	....

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In com-

paring one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions:

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product 1909		Product 1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	......	12,560,032	......	4,961,072	1,090,233	$1,060,998	2,359,731
Apples	36,055	1,138,852	29,044	1,127,573	168,008	160,655	591,985
Peaches and nectarines	108,959	9,737,827	47,712	2,958,813	729,631	703,649	1,400,240
Pears	40,397	558,478	25,652	448,899	110,967	114,279	166,418
Plums and prunes	46,013	1,020,339	20,609	327,765	75,222	77,925	180,813
Cherries	4,784	29,439	4,131	43,712	1,062	663	2,189
Apricots	14,497	66,533	8,831	47,895	1,839	2,364	1,620
Quinces	754	6,441	647	5,433	1,869	740	(2)
Mulberries	183	2,123	111	982	1,635	723	(2)
Unclassified	......	......	......	......	......	......	[3] 16,466
Grapes	13,495	712,201	6,829	297,869	[4] 1,802,618	78,325	[4] 4,086,220
Nuts, total	......	[5] 1,104,360	......	[5] 638,480	[4][5] 5,945,932	[5] 562,542	[4] 1,836,970
Persian or English walnuts	626	9,685	704	13,015	40,658	3,703	10,400
Almonds	207	4,534	145	1,528	16,932	1,618	......
Pecans	10,519	1,087,619	6,171	621,550	5,832,367	556,203	1,810,670
Black walnuts	280	1,820	147	1,206	55,446	995	(2)
Unclassified	......	......	......	......	......	......	[3] 15,900
Tropical Fruits, total	......	[6] 287,500	......	[6] 1,473,818	......	[6] 122,678	......
Japanese persimmons	174	4,449	190	2,718	1,175	2,136	31
Oranges	494	42,384	2,560	867,407	[7] 10,694	22,090	......
Figs	11,380	230,171	6,450	585,396	[4] 2,411,876	97,078	[4] 611,460
Pomeloes (grapefruit)	116	4,544	287	8,768	[7] 488	866	......
Lemons	125	1,231	541	7,231	[7] 224	469	......

[1] Bushels.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Pounds.
[5] Includes chestnuts, hickory nuts, chinquapins, Japanese walnuts, Spanish walnuts, filberts, Japanese chestnuts, French walnuts, hazelnuts, butternuts and other nuts.
[6] Includes dates, bananas, pineapples and pomegranates.
[7] Boxes.

The total quantity of orchard fruits produced in 1909 was 1,090,000 bushels, valued at $1,061,000. Peaches and nectarines contributed about two-thirds of this quantity; apples, pears and plums and prunes most of the remainder. The production of grapes in 1909 amounted to 1,803,000 pounds, valued at $78,000, and that of nuts to 5,946,000 pounds, valued at $563,000. The tropical fruits produced in 1909 were valued at $123,000.

The production of all orchard fruits together in 1909 was 53.8 per cent less in quantity than in 1899, and the production of grapes also decreased. The value of orchard fruits decreased from $1,345,000 in 1899 to $1,061,000 in 1909, and that of grapes from $126,355 in 1899 to $78,325 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule:

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	114	(1)	Gals.......	4,803	55,566
Vinegar	572	0.1	Gals......	10,039	43,659
Wine and grape juice	731	0.2	Gals......	42,036	104,987
Dried fruits	563	0.1	Lbs......	26,189	84,630

[1] Less than one-tenth of 1 per cent.

Frost and Precipitation in Texas

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Amarillo	Nov. 7	April 12	Oct. 16	May 23	21.9
Mt Blenco	Oct. 30	April 10	Oct. 18	April 30	15.6
Paris	Nov. 15	Mar. 28	Nov. 3	April 12	33.3
Abilene	Nov. 15	Mar. 15	Oct. 25	April 7	24.5
Dallas..	Nov. 15	Mar. 26	Nov. 3	May 1	36.8
Longview	Nov. 16	Mar. 19	Oct. 26	Mar. 31	47.2
El Paso	Nov. 10	Mar. 20	Oct. 30	April 22	9.3
Waco	Nov. 10	Mar. 16	Nov. 3	April 5	35.4
Palestine	Nov. 13	Mar. 13	Oct. 20	Mar. 30	44.5
Menardville..	Nov. 12	Mar. 31	Oct. 24	May 1	22.6
College Station	Nov. 20	Mar. 5	Nov. 3	Mar. 24	37.8
Fredericksburg	Nov. 15	Mar. 17	Oct. 21	Mar. 28	28.4
Houston	Nov. 27	Feb. 21	Nov. 4	Mar. 26	48.2
Fort Clark	Nov. 18	Feb. 22	Nov. 2	Mar. 19	23.4
San Antonio	Nov. 30	Feb. 25	Nov. 9	Mar. 19	26.7
Galveston.	Dec. 25	Feb. 5	Dec. 4	Mar. 1	47.6
Beeville......	Dec. 7	Feb. 18	Oct. 21	Mar. 6	28.9
Corpus Christi	Dec. 25	Feb. 27	Nov. 30	Mar. 19	26.8
Fort Brown.............	Dec. 13	Feb. 18	Nov. 15	Mar. 5	28.2

Southern Texas

For Bloom Periods of Apples, see *Louisiana*.

Thermal Belts. See *Selecting Site for an Orchard*, under *Apple Orchard*.

Timbered Land, Preparation of. See under *Apple Orchard*.

Toads

Although he is a lowly creature and not beautiful to see, the toad may be just as valuable as some of the more valuable birds whom we have come to prize because we have learned what they have done for us. Besides, Mr. Toad seems to realize that he is not beautiful and so keeps out of sight most of the time, performing his useful labors at night.

The toad lives several years and if he is treated well will remain in the same feeding-ground all his life. He lives mostly upon worms and bugs, the largest percentage of which are harmful to man in some way. He eats a few angleworms, but we will give him all he wants of these if he will only keep up his war on the cutworms, which he takes especial delight in devouring. The cutworm does his work at night, and that just suits Mr. Toad. Hopping about under the cabbage plants or the beans in the evening, he locates the cutworm at his work and, quicker than "scat," down he goes to trouble us no more! By counting the worms in the stomachs of many toads it has been estimated that during May, June and July a full-grown toad will eat 2,160 cutworms. Gardeners sometimes pay as high as a cent apiece for cutworms. At this rate a

toad will be worth $21.60. Indeed, in France gardeners sometimes pay $25 per 100 for them, besides offering other "special inducements" in the way of convenient places to hide in the daytime or a little pond in which to breed in the spring. Besides the host of cutworms the toad will eat 1,800 thousand-legged worms, 2,160 sow-bugs, 3,240 ants, 360 weevils, etc. He will thus destroy in three months 9,720 injurious insects. Greenhouse men frequently cultivate their acquaintance for their value in keeping down slugs, sow-bugs, plant lice and other greenhouse pests.

They may be encouraged to stay if shallow holes are dug for them and covered with a flat stone or board, where they may hide in daytime.

Tomato

One of the nightshade family, and closely allied to the potato, grown more in the United States than anywhere else. A native of Western South America.

Pear Tomato.

Tomato Culture

W. H. Wicks

*Where the growing season is short, due to late spring and early fall frosts, tomato growing is not encouraged. The vines under these conditions will develop a heavy yield of fruit but they cannot mature it.

Location

In Northern Idaho and Washington the desirable locations for tomato growing are to be found on the warm slopes of the rolling hills which comprise the Palouse country. Freedom from frost, good soil drainage, and distance from market or transportation must be carefully considered by the prospective tomato grower. If one can locate in a district where a canning factory is established, it will be found a great aid in disposing of that part of the crop which he does not care to pack for fancy trade.

* Idaho Experiment Station Bulletin 76.

Soil

The tomato adapts itself quite readily to a number of different types of soil. Such factors as frost, length of growing season, altitude, sunshine and moisture supply, influence the total results in tomato growing so strongly that the character of soil is to be made one of the least considerations.

The type of soil which will warm up early in spring and retain moisture reasonably well is to be preferred over those soils which are commonly spoken of as "late." Especially is this true in the non-irrigated sections where a longer growing season is desired.

Seed

Seed should be purchased from some firm which makes a specialty in tomato seed. It is seldom wise for the tomato producer to grow his own seed, unless he intends to select for certain characteristics which will keep up the type of the variety which he is growing or unless he is endeavoring to secure new strains.

Careful judgment should be exercised in choosing tomato seed. Good seed must be true to name, viable, pure, and be of the greatest possible longevity. Buy the best seed that the reliable seed man has to offer. Buying cheap seed is poor economy. Seed should be ordered in ample time to secure a good choice. Some growers test their seed before planting, which is a very desirable practice, but a larger number of plants than necessary should always be grown, to give an opportunity for selecting only strong, vigorous plants for planting.

Varieties

The tomato fluctuates rapidly according to environmental factors. This should be kept in mind at all times. Novelties are constantly appearing and disappearing. The grower must decide which are the most desirable for his use. The range of conditions found in the Northwest has

an important bearing upon the success or failure of a variety, and the growing of a variety for one year is not sufficient to determine conclusively its merits or defects.

A variety test should extend over a series of years. Work at experiment stations shows that new varieties are usually great yielders. In some cases, after a few years they run out and are replaced by others. Such varieties usually run high in yield for the first few years. Examples of this performance may be illustrated by the Ignotum, Greater Baltimore and others.

I desire especially to recommend Atlantic Prize for the home garden. Spark's Earliana also is a most desirable early variety. Early Ruby, Sutton's and Stone are subject to rot, a disease which attacks the blossom end about the time of ripening.

Varieties Tested at Virginia Station

The following table, giving a list of varieties, is taken from Bulletin 8 of the Virginia Truck Experiment Station, of Norfolk, Virginia. This bulletin was published May 1, 1912. While this list has not been tried in the various sections of the Northwest it will be found useful from which to select varieties for trial.

Table 1

Variety—	*Character of Growth.	†Color of Fruit.	‡Form.	First Ripe Fruit at Idaho Station.
Acme	S	P	R	July 9
Atlantic Prize	W	R	R	July 6
Beauty	S	R	R	July 9
Buckeye State	S	P	R	July 11
Chalk's Early Jewel	M	R	R	June 26
Cherry	S	R	R	June 27
Cherry	S	Y	R	June 22
Coreless	S	R	R	July 19
Crimson Cushion	S	R	R	July 11
Dwarf Aristocrat	S	R	R	June 19
Dwarf Champion	S	P	R	June 19
Dwarf Purple	S	P	R	June 26
Earliana	M	R	R	July 6
Earlibell	W	R	R	June 27
Early Freedom	M	R	R	July 6
Early Jewel	S	R	R	July 19
Emperor	S	P	R	July 11
Favorite	S	R	R	June 26
Globe	W	P	R	June 26
Golden Ball	S	Y	R	June 26
Grandus	W	P	R	June 30
Honor Bright	S	R	R	June 30
Hummer	S	R	R	June 19
I. X. L.	W	P	R	June 19
June Pink	M	P	R	July 19
Magnitude	S	R	R	June 26
Magnus	S	P	R	June 27
Mascot	M	P	R	July 9
Matchless	S	R	I	July 9
Mikado	M	P	R	July 9
New Discovery	W	R	R	June 19
Norfolk	S	R	R	July 9
Peach	W	P	R	July 11
Pear	M	R	R	July 6
Pear	S	Y	R	July 6
Perfection	S	R	R	July 6
Plum	S	R	R	June 27
Ponderosa	S	R	I	July 19
Royal Red	S	R	R	June 30
Stirling Castle	M	R	R	June 26
Stone	S	R	R	June 30
Tenderloin	M	R	R	June 30
Trophy	M	R	R	June 26
Yellow (large)	S	Y	R	July 19

* S—strong; M—medium; W—weak.
† P—pink; R—red; Y—yellow.
‡ R—regular; I—irregular.

For a market tomato one should choose a type of fruit which has few seeds, thick, meaty cavity walls, tough skin, and runs uniform in shape and color. For canning a type should be chosen with the following characteristics:

1. Flesh firm and well formed.

2. Fruit smooth and without depressions.

3. Vine a good grower, with strong stems and resistant to disease as far as possible.

4. Plant producing a large yield of fruit throughout the season.

5. Uniform red color that remains bright during the preserving process.

The Stone variety is grown considerably for canning purposes in some states and is a good variety for the Northwest.

Other varieties worthy of trial are: Bolgania, Royal Red, Greater Baltimore, Livingston's Globe, Field's Early June and Maul's Success. As already stated, the varieties fluctuate rapidly, and while these varieties are generally mentioned today for canning purposes they may not be as desirable as others in the future.

Method of Starting the Plants

While the use of the greenhouse facilitates the work and is the ideal way to start plants, yet equally good results may be secured by the use of a hotbed. In either method the gardener is compelled to exercise his best judgment and attention to bring out strong, thrifty plants.

Seeding the Hotbed

When the temperature of the hotbed is satisfactory, the soil should be made ready at once for seeding. Care should be taken in handling the soil so that it will be absolutely level and uniformly firm throughout the bed. If not, trouble will be found when the first few waterings are given. This will cause the soil to wash from one side of the bed to the other. The time of planting the seed depends upon the local conditions. It varies from year to year, so the grower will need to use his best judgment on this point.

Seed can be sown in rows four inches apart and from four to five seeds to the inch. At this distance one ounce of seed will plant about two sash. For enough plants to plant one acre and also allow for the rejection of inferior plants, from one to three ounces of good seed are necessary.

Hotbed Management

The points to consider in managing a hotbed are:

1. Maintaining the proper heat.
2. Ventilating.
3. Watering.
4. Hardening off.
5. Transplanting.

When the seed is planted, close the hotbed and keep the temperature recorded by the use of a thermometer. The frame will need ventilation, and especially on bright days. This will prevent the temperature running too high. Fresh air must be given every day. This is accomplished by sliding or raising the sash. Weather conditions govern the distance that the sash is moved. In cold or windy weather the bed should be opened slightly for a few minutes two or three times a day. In changing the air of a hotbed never allow the plants to become chilled by a strong, cold wind blowing directly upon them. If the weather turns unusually cold protect the plants by covering the sash with matting made for the purpose or with heavy burlap or material of that nature. See that this covering is removed as soon as possible each morning so the plants may have the benefit of all the light. This will prevent them from growing weak and slender. There can be no best system worked out for the management of the hotbed, because of the fact that conditions vary so much and rapidly.

Experience will soon prove the best way to manage a hotbed. As a rule beginners are apt to start plants too early. A tomato plant should be stalky, strong, and vigorous when ready to leave the hotbed for the cold frame for the hardening off process.

Transplanting Seedlings

A new hotbed should be made ready for receiving the seedlings, which should be transplanted about three weeks from the time the seed is planted. They can now stand from three to four inches apart. See that the conditions are congenial in the new bed before the transfer is made. Dig up the seedlings with as much of the roots and soil as possible. A trowel is very convenient for this. The plants are usually set with a dibber and should be placed in the ground almost to the seed leaf. Firm the soil well about the roots. This is important. Water the plants immediately after setting.

The management of this bed is practically the same as for the seed bed. The weather at this time becomes warmer, so the plants may be exposed more from day to day. During the process of transplanting see that the plants are not exposed to the cold or drying winds. The amount of hotbed space for receiving the seedling will be about four times as great as the seed bed.

Cold Frames

A cold frame differs mainly from a hotbed in that it has no bottom heat. It should be placed near the hotbed, where the same careful attention may be given. In most parts of the Northwest sash covered with cloth may be used instead of glass. However, cloth-covered sash is not as safe. It is advisable in some localities where strong winds prevail to bank up the outside of the coldframe with coarse material such as strawy manure.

Transferring Plants to the Cold Frame

Just before the plants begin to crowd in the second hotbed, shift them to the cold

frame. The soil should be of a good composition and plants may be set in this six inches apart. This gives them room until they are transferred to the field.

The management of the cold frame differs materially from that of the hotbed. The season becomes warmer and the sash may be left entirely open the greater part of the day. However, the gardener must watch for cold, cloudy days, when the sash will need to be left on. Ventilation should be given each day. There is usually danger of a sudden drop in temperature during the first days of spring. The grower should see that the cover of the cold frame is always put on at night during this season of the year. Wnen frost is feared add additional cover to the frame.

Hardening of the Plants

It is necessary to gradually harden off the tomato plant in the cold frame to prepare it for field conditions. If they are properly hardened and handled in transferring, they should receive no check in growth. Begin to harden the plants from two to three weeks before they are set in the field. This is done by leaving the cold frame uncovered late each day and having the sash raised to admit night air. As the nights become more congenial, the cover may be left off entirely. When thus handled they are in good condition for setting in the field.

Setting Plants in the Field

The date of setting plants in the open ground varies greatly, due to different altitudes, kinds of soil, and climatic conditions.

Much care should be exercised at this time to see that the root system is not molested or exposed to wind or sun while being transferred from the hotbed to the field. Where plants are grown in the hotbed, a small cube of dirt should be raised with a sharp spade. If a four-inch flower pot is used no difficulty will be experienced in molesting the root system. This latter method is recommended.

Every precaution should be made to put the field in the best condition and tilth for the reception of the plants. Fall plowing of the garden ground is the most satisfactory and it should be left in the rough. The following spring, as soon as it is sufficiently dry, disk thoroughly, which process will pulverize the large particles, break up the crust, and prevent loss of moisture. Several weeks may elapse between the time of the first working of the soil and the date when the danger of late killing frost is over.

Just before setting the plants give the ground a thorough harrowing. Furrows are now made crosswise of the field by using a single-shovel plow or one-horse turning plow. When furrows are made in the other direction the plants are set where they cross. The cross-furrows should not be made, however, any faster than the planting is done, as this gives plenty of loose, moist earth to be used in setting the plant. The distance for planting varies with the individual grower. The average distance for planting to accommodate the nature of growth of commercial varieties is from four by five to five by five feet. Some growers recommend that the plants be set in rows four or five feet apart and the individual plants four to three feet apart in the row. It is well for the grower to plant a sufficient distance apart and have rows run straight in two directions so practically all of the cultivation can be done by horse power.

In some of the large commercial tomato-growing districts planting is done by machine. Machine planting is recommended only where a large acreage is being planted. See that the plants are set deep and firm. The size of the plant causes the depth of planting to vary, but well-grown, stocky plants should be set from five to six inches deep and firmly. Long-stem plants may be set deeper.

Table 2

Cost per Acre for Planting Tomatoes

	1910	1911	1912	Aver.
Marking rows...	$0.95	$1.20	$0.80	$0.983
Hauling plants...	1.80	2.80	1.60	2.066
Setting plants...	3.65	3.45	4.50	3.866
Gathering pots in field	.35	.30	.40	.35
Totals	$6.75	$7.75	$7.30	$7.265

NOTE.—Fifty cents per hour was paid for man and team, 20 cents per hour was paid for hand labor.

Table 3—Average Cost of Pruning and Training Tomato Plants for Three Years

	Time		Cost	
	Pruning	Training	Pruning	Training
Plat 1	5.02 hrs.	4.79 hrs.	$1.00	$ .96
Plat 2	5.57 hrs.	4.83 hrs.	1.11	.97
Plat 3	6.75 hrs.	3.79 hrs.	1.35	.76
Plat 4	....	6.38 hrs.	....	1.28
Plat 5	3.31 hrs.	4.83 hrs.	.66	.97
Plat 6	6.51 hrs.	5.30 hrs.	1.30	1.06
Plat 7	6.59 hrs.	5.79 hrs.	1.32	1.16
Plat 8	....	7.43 hrs.	....	1.49
Plat 9	3.44 hrs.	....	.69	....
Plat 10	4.93 hrs.	....	.99	....
Plat 11	5.70 hrs.	....	1.14	....
Plat 12	....	....	....	....

Table 3 shows that the expense of pruning is greater than the expense of training. Attention is also called to the fact that when training alone is done, it is more expensive than when both pruning and training are performed. This is accounted for in the fact that the workmen while pruning are also lifting the plants and tying them to their support, but in the case of training and no pruning, the plants are more difficult to handle and therefore require more time.

Effect of Pruning and Training on Date of Ripening

The popular opinion in the Palouse country is that tomatoes do not mature sufficiently early to make a profitable crop. It is important in the Palouse country to select for tomatoes the warmer spots which enjoy the greatest freedom from early fall frosts.

Experiments at the Idaho station, 1910-12, showed that pruning to one stem and staking hastens maturity over other methods employed.

Effect of Pruning and Training on Yield of Fruit

Plants that receive no pruning and no training on trellis produce the greatest number of boxes of all grades of fruit. The net profits, however, are likely to go to the plants which receive no training, on account of the cost of training.

Cultivation

Begin cultivation as soon as the plants are set. This loosens the soil, and forms a dust mulch. See that this mulch is maintained throughout the growing period. It prevents evaporation of moisture from the soil. The first few cultivations may be made deep and reasonably near the plant, but later cultivation should be sufficiently shallow so that none of the root system will be molested. In the non-irrigated sections cultivation should be given every ten days or two weeks and after a rain. In the irrigated sections the cultivation should be given just as soon as the ground is sufficiently dry after each irrigation.

Cultivation in this manner will prevent the appearance of weeds, and time spent in thorough cultivation will be amply repaid. When the fruit begins to ripen, cultivation should cease almost entirely. Two or three cultivations during the ripening period will enlarge the yield. It should be done with care, as the root system can be easily injured. Injury at this time is serious. A one-horse cultivator of the Iron Age or Planet Junior type is a very good tool for doing this work.

Irrigation

Due to variation of soil and climatic conditions of the irrigated sections no rule can be laid down for the irrigation of tomatoes.

See that the newly set plants have one good application of water which is sufficient to moisten the soil at the greatest depth possible.

Begin cultivation immediately, and at all times endeavor to preserve moisture in order to lessen the number of irrigations. Under ordinary conditions possibly three irrigations would be sufficient,

but the grower must necessarily determine this for himself after the study of his soil and the behavior of his plants. As a rule when the fruit begins to mature more water will be needed than in the earlier life of the plant.

Picking

Only ripe fruit should be picked when it is to be sold on the local market. For shipping it must be picked much greener, as it ripens in transit. Over-ripe or "leaking" tomatoes cannot be handled profitably. This will necessitate frequent gathering, and all plants should receive equal attention, in order to prevent some fruit from becoming over-ripe.

The tomato must be carefully picked. It is very easily bruised, and a picking basket lined with some soft material like burlap may be found convenient. There are many styles of picking utensils on the market. One will have no difficulty in choosing a satisfactory type.

Tomatoes collect considerable dust while growing. If spraying has been done for disease or insect pest it also is noticeable. Therefore, every fruit should be carefully wiped. This can be conveniently done just before they are placed on the packing table.

Grading

Before placing the tomato upon the market have it carefully graded, fancy, second, and culls. Accuracy in grading pays well on any market. In this way a reputation can be secured and maintained.

The tomato that is sound, smooth, regular in shape, free from cracks and blemishes, is packed as fancy. Second-grade tomatoes consist of those specimens which are slightly inferior to the fancy grade in smoothness, size or extent of cracks, but ripe and make a uniform pack. All rough, over-ripe, cracked, or unsightly specimens are classed as culls.

Packing

The Western Standard tomato box is made in two sizes—length, 18½ inches; width, 11½ inches; depth, 3½ inches. The other size is, length, 18½ inches; width, 11½ inches; depth, 4 inches. This box is used both for local market and export. A careful packer will see that no package leaves the field defective in regard to quality of pack, name of variety, and any labeling that the grower is using to establish his reputation. As a rule, the market demands that this style of package be only for the fancy and second grade.

In some markets, principally in the Middle West, the four-basket crate is used. This is especially preferable for fancy, early tomatoes. The dimensions of this crate are 22 inches x 13 inches x 4⅜ inches, and contains four baskets, each one being 10 inches x 6¼ inches at the top, 8½ inches x 4¾ inches at the bottom, and 4 inches deep. This is the standard package for tomatoes produced in Southern Illinois.

Throughout the Boston market district the favorite package for tomatoes is the Boston bushel box. While there are some districts in this state able to produce a fancy early tomato, the type of container is governed by the demand of the market. As most of the fruit is consumed in local markets, probably there will be no change from our present package.

For canning purposes some canneries prefer to furnish the crates to the grower. These crates hold about 50 pounds, and are constructed to prevent any injury to the fruit. No crate of tomatoes should be delivered to the canning factory in a dripping or otherwise defective condition, as only choice fruit will produce the first-grade canned product.

Marketing

The prospective tomato grower should ascertain his market before planting extensively. A few tomato growers can supply the local market in towns averaging from 4,000 to 5,000 people, but in localities where a cannery is in operation the fruit can be disposed of at a profit first to the fancy trade and then to the cannery.

Yields

In a good season, with proper care of vines and without exceptional loss from disease or insect attacks, the yield may

be expected to run from five to twelve tons per acre. Occasionally a good tomato grower secures even a higher yield than this.

It is assumed that the commercial tomato grower will fertilize his ground each year with well-rotted stable manure or its equivalent. This should increase his yield each year very materially. The tomato responds readily to fertilization. An excess of nitrogen causes a rank growth of the plant at the expense of the fruit. A study of the amount of fruit and vine on each plant will aid the grower in the question of handling the fertilization.

CROSSING TOMATOES TO INCREASE THE YIELD

"New Blood Gives New Vigor"

Stock breeders have long recognized the principle that mating animals of different strains, races or varieties of the same or closely allied species usually gives offspring of great vigor and frequently of larger size than the parents. This view had received some recognition from scientists even before the time of Darwin; but he collected so many illustrations of its truth among both animals and plants that biologists generally accepted the principle as one of nature's laws, though it is a law with exceptions. Other students and investigators since Darwin's time have tested this law in many fields, and, among others, have proven it true with corn, beans, sorghum, cotton, tobacco, peas and other farm crops.

In order to test this law in the case of tomatoes, Richard Wellington, of the Geneva station, New York, undertook an experiment covering four years, which resulted in first generation crosses from standard parents giving more ripe fruit and larger total yield by 2½ tons of ripe fruit and 4½ tons total yield.

It is only in the first generation that this favorable influence is likely to be profitable.

Why Does Crossing Increase Yield?

The fact that crossing parents not too closely nor too distantly related increases the vigor, size and productivity of the offspring is apparently well established; but only recently has any plausible explanation for this effect of cross-breeding been given. Now, however, Mendel's experiments and observations on heredity have given at least a workable theory to account for this increase in size or vigor in the first generation of descendants from parents of diverse characteristics, and the rapid disappearance or reversal of this favorable effect in subsequent generations.

Practical Suggestions for Seed Growing

High-yielding mother plants should be chosen two or three generations previously. This can easily be done, and the strain kept pure, since tomatoes are readily self-fertilized. These high-yielding strains should be continued and new crosses made as new seed is needed. The crossing need not be done every year, since tomato seed retains its vitality for at least three years, so that enough crossed seed could be secured in one season to grow the crop for three years to follow. But the tomato grower who does not regularly raise his own seed must buy the crossed seed each year unless he wishes to find his second-season crop running down in yield. The improvement in yield is not inherent in the strain; it is merely the result of the crossing.

Too violent crossing must not be attempted, else sterility will result, as in the well-known case of the mule. In crossing the tomato and Jerusalem cherry total sterility resulted.

The best results can probably be secured by keeping within the species and crossing the distinct varieties and the distinct strains; and in selecting these, regard must be paid to the inheritance of such qualities as smoothness, color, shape, size and earliness. To obtain smooth fruits only varieties producing smooth, even-surfaced fruits should be used, since roughness appears in the first generation. If dark red tomatoes are desired, one of the parents at least must be dark red; but the other may be red, pink or yellow, since the red is a stronger character than the pink or yellow, and will hide them in the first generation. If pink is desired the red must be avoided and two pink varie-

ties or a pink and a yellow used; while to get yellow fruits both parents must be yellow.

Size appears to be inherited in a blended condition, as it is probably not a unit character; therefore, to obtain tomatoes of large size, both parents must produce large fruits; to produce small ones both parents must be small-fruited; while to produce medium-sized fruits, either medium-fruited parents must be crossed or small-fruited and large-fruited types. The same condition prevails with regard to general shape as with size—an intermediate inheritance; and earliness probably follows the same rule.

F. H. HALL,
Geneva Bulletin 346.

Literature on Tomato Culture

Bailey, L. H. Encyclopedia of Horticulture. (E-M), p. 956.

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Tracy, W. W. Tomato Culture, p. 4.

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Harland, Marion. School for Housewives.

Bailey, L. H. Survival of the Unlike, pp. 480-485.

Virginia Experiment Station Bulletin 177.

Georgia Experiment Station Bulletin 96.

The Tomato Pack of the United States, by States, 1908-1911, as Reported by the Secretary of the National Canners' Association

STATES	1908	1909	1910	1911[1]
	Cases	Cases	Cases	Cases
Maryland	4,716,000	4,609,000	3,675,000	3,908,000
Delaware	940,000	1,236,000	992,000	931,000
New Jersey	653,000	944,000	519,000	570,000
Indiana	1,126,000	852,000	537,000	806,000
Ohio	406,000	339,000	209,000	293,000
New York	369,000	298,000	118,000	193,000
Missouri	546,000	244,000	350,000	120,000
Virginia				
West Virginia	607,000	985,000	630,000	681,000
Washington				
Utah				
Colorado	779,000	930,000	463,000	444,000
California[2]				
Iowa				
Michigan				
Illinois	546,000	247,000	258,000	269,000
Minnesota				
Pennsylvania				
Tennessee	611,000	223,000	164,000	188,000
Kentucky				
All other states	182,000	77,000	116,000	46,000
Totals	11,479,000	10,984,000	8,031,000	8,449,000

[1] Included in the above are 390,000 dozen No. 10 tomatoes and 1,818,000 No. 2 tomatoes, all of which have been equalized to represent No. 3, for the purpose of comparison. In some states where 2½ size has been used totals have been made to equal 3s, and they are not otherwise shown.

[2] The statistics of 1910 were issued on December 6th, at which time the California tomato pack was in progress and figures unobtainable. Therefore, totals of this state were omitted.

The figures for California since completed are:

1910, equalized to 3s 1,204,000
1911, equalized to 3s 1,300,000

To prevent confusion or misunderstanding, the figures of this state are given in this explanatory note.

TOMATO DISEASES

Anthracnose

Colletotrichum sp.

One or more fungi are responsible for a fruit rot. It generally causes sunken blotches on the side of the mature fruit, and in severe cases the whole fruit eventually becomes affected and decay quickly follows. The disease has been described by different writers, and its appearance has been noted in widely separated localities.

Rolfs, who has had considerable experience with this disease claims that it can be held in check by Bordeaux mixture.

G. E. STONE,
Massachusetts Bulletin 138.

BLACK ROT. See *Blossom End Rot*, this section.

Blight

Bacillus solanacearum Smith

This disease has caused considerable injury South. E. F. Smith has fully described the disease and recommended as precautions against it an early and complete destruction of insect pests, and the removal of any diseased vines. He also advises the use of land on which there have been no diseased plants, together with seed taken from localities where the disease has not existed.

J. S. Robinson found that by spraying plants affected with this blight three or four times in the summer with Bordeaux an increased yield of two to two and one-half tons per acre was obtained.

See also *Downy Mildew*.

G. E. STONE,
Massachusetts Bulletin 138.

Blossom-End Rot—Point Rot

F. D. BAILEY

This disease is quite generally distributed throughout the country. It seldom causes extensive loss, but from the fact that it is more serious on the early crop, the financial loss becomes a factor of importance.

This rot may occur at various stages of development of the fruit, generally before it has reached full size, and, as has been stated, early in the season. It makes its appearance at the blossom end in the form of sunken brown spots which gradually enlarge. Such spots are dry and hard. Many times molds or bacteria gain entrance at this point when the fruit is imperfect and cause decay. Such troubles should not be confused with the one under consideration, although they frequently follow it.

Fig. 1. Blossom End Rot of Tomato. Early stage, late stage and cross section.
—*Georgia Experiment Station.*

The true cause of point rot does not seem to be thoroughly understood. There is evidence to indicate that it is an infective disease, the cause of which is distributed by insects.

It is known that the trouble is more serious in dry weather on light soils where the supply of water is insufficient. This can be corrected either by irrigation or by adding organic matter so that the water-holding power is increased. Surface tillage should also be practiced. Experimental work has shown that sub-irrigation is better than surface watering, and that where plants are shaded so that transpiration is reduced the amount of rot is considerably lessened.

Burn or Scald

A disease of rare occurence characterized by drying up of leaves. It is an indoor disease attributed to burning from sudden exposure to bright sunshine after cloudy weather, or to lack of water, especially when plants have been accustomed to warm, moist air and plenty of water. Plants grown under optimum temperature conditions in properly lighted and ventilated houses, especially where attention has been paid to their care during cloudy weather, are not likely to be affected with this trouble.

G. E. STONE,
Massachusetts Bulletin 138.

Collar Disease

Vermicularia sp.

A peculiar collar disease of fall greenhouse tomatoes. The symptoms are an abnormal leaf development, after the manner of mosaic disease by artificial inoculation.

The case under study occured in houses that appeared to be overwatered. The plants set very little fruit and were not profitable. The root system normally developed except in adventitious whorl of roots near the surface. Between these roots and the root crown below, the collar of the plant is surrounded by a development of what appears to be a parasitic fungus, a species of Vermicularia. The black masses of the fungus are also visible extending down upon the root bases, which are lighter in color. A similar abundance of Vermicularia has been noted on the dead stems of potato tops which have died from fusarium blight.

Something can be accomplished by spraying with Bordeaux mixture about the base of the plants. Certainly good will come by withholding excess water.

A. D. SELBY,
Ohio Bulletin 214.

DAMPING OFF. See *Root Rot*, this section.

Downy Mildew, Blight

Phytophthora infestans

F. D. BAILEY

This disease is due to the same cause as the late blight of potato. It has been quite prevalent in certain sections of the Northwest where the potato blight occurred during the season of 1912, and it has caused the loss of a large percentage of the crop in some cases. (For full account see late blight of potato.)

Fig. 1. Late Blight of Tomatoes. Caused by the same fungus as the late blight of potatoes.

DRY ROT or DRY WEATHER ROT. See *Blossom End Rot*, this section.

EEL WORMS. See *Root Knot*, this section.

FRUIT ROT. See *Blossom End Rot*, this section.

Hollow Stem

P. H. Rolfs mentions this trouble as occuring in Florida. Plants suffer from this disorder immediately after being set

out. The central portion of the plants remains green, while the large leaves turn slightly yellow; then in the course of a week or ten days the most severely affected fall over. On examination it is found that the lower part of the stem is hollow. The trouble is caused by forcing the plants in the seed bed, and anything which induces a soft watery growth is likely to cause hollow stem. Quick growing varieties are more likely to be affected, and transplanting before hardening off the plants is favorable to the trouble.

G. E. STONE,
Massachusetts Bulletin 138.

Leaf Blight, Rust

Cylindrosporium sp.

Considerable trouble has been experienced with this blight on Long Island* and in New Jersey.** It occurs as brownish spots on the leaves, and as the trouble progresses it involves the whole leaf, causing it to turn brown and dry up. In severe cases of infection practically all of the foliage may be destroyed.

The trouble has occasionally been observed on greenhouse tomatoes.

For field crops spraying has been recommended. In the greenhouse the remedy is more simple, since the disease results from too much crowding.

A similar spot is often found on chrysanthemums. On both tomatoes and chrysanthemums the disease is confined to the lower shaded leaves of closely planted crops, and is never observed on individual plants of chrysanthemums grown in pots or where light and air have access to the foliage. In the fall and winter, when the light is poor, the lower leaves of crowded plants often deteriorate and show signs of prematurity; consequently becoming more susceptible to disease.

To prevent this trouble the crop should not be planted too closely, and the foliage should receive more air and sunlight. On too closely planted tomato plants the lower leaves may be removed, and if diseased, destroyed. The pruning of the lower leaves is not harmful and lets in more light and air where it is needed.

* New York (Geneva) Agricultural Experiment Station, 14th Annnual Report, 1895, p. 529.

** New Jersey Agricultural Experiment Station, 15th Annual Report, 1894, p. 361.

Leaf Blight

Septoria sp.

Leaf blight is frequently seen on field crops of tomatoes. It is reported as being rather serious in New Jersey, Ohio and the south, and it has recently caused much trouble in the Middle West.

This disease is distinguished from other leaf diseases by the presence of circular spots, at first appearing on the lower leaves. The infection increases with the development of the plant, and in severe cases little remains of the plant but bare stems and small, stunted fruit. It yields to treatment with the Bordeaux mixture. The first spraying should be given about two weeks after transplanting, followed by two or three additional sprayings at intervals of three weeks.

G. E. STONE,
Massachusetts Bulletin 138.

Leaf Mold

Cladosporium fulvum

F. D. BAILEY

This fungous disease is often found on tomatoes when raised under glass. In the South it is sometimes destructive in the open. In the Northwest where greenhouse men are familiar with it, little concern is felt, for while the foliage is somewhat decreased in efficiency, it attacks only the older leaves, and the plants mature a good crop. The yield is proably held down, however, and careful comparative tests will doubtless show the advisability of spraying.

Symptoms

This fungus attacks the older leaves, causing yellow spots to appear on the upper surface. On the lower side these spots are darker in color, and on close examination will be found to be covered with a gray-colored mold or fungus. Many spores capable of spreading the fungus are produced on this growth. Air currents, water or insects furnish means of scattering to other leaves.

Control

The most satisfactory method of control is the maintenance of dry atmosphere. The foliage should be sprinkled only on very bright dry days. It is claimed that sprinkling lime-sulphur on the heating pipes has checked the fungus.

Leaf Mold

Alternaria Solani (E. & M.) Jones & Grout.

The fungus causing leaf mold is the same as that giving rise to the early blight of potatoes. It often occurs on the leaves and fruit of field crops. The leaves affected with this fungus present at first minute spots, which gradually enlarge and become marked with concentric lines. These spots are sometimes associated with the injuries caused by the flea beetle.

The remedy advocated is similar to those that are applied for the early blight of potatoes, namely, spraying with some good fungicide.

MILDEW. See *Leaf Mold*, this section.

Mosaic Disease

The so-called mosaic disease,* which is common to tomatoes, is characterized by a peculiar yellow spotting of the upper surface of the leaves. These yellow spots, particularly when exposed to bright sunlight, subsequently become purplish in color, and the margins of the leaves curl up. Many crops are affected with what is termed "mosaic trouble," and in all cases this is associated with too extensive pruning. The more a tomato plant is pruned the more likely it is to be affected with the mosaic disease, and topping or pruning of the leader induces this trouble more than other methods of pruning.

The mosaic disease is apparently a functional trouble, and little is known about it. Similar troubles are associated with tobacco (calico) and are believed to be infectious. The presence of this disease on tobacco is thought by some to be associated with certain methods of transplanting. The disease on tomatoes does not destroy the foliage of the plant, but the abnormal metabolic processes which appear to be associated with this disease apparently affect the yield.

* Bureau of Plant Industry, U. S. Department of Agriculture, A. F. Woods, Bulletin 18.

NEMATODES. See *Root Knot*, this section.

Oedema

This peculiar trouble of greenhouse tomatoes was first investigated by G. F. Atkinson* of Cornell University, who made an exhaustive study of it. He diagnoses the disease as follows:

"Oedema of the tomato is a swelling of certain parts of the plant brought about by an excess of water, which stretches the cell walls, making them very thin and the cells very large. The excess of water may be so great that the cell walls break down, and that part of the plant dying, exerts an injurious influence in adjacent parts."

The cause of Oedema is insufficient light, too much water in the soil and too high a moisture content of the air. It is an abnormal disease of very rare occurrence, and should cause no trouble if good judgment is exercised in growing the plants.

Oedema is easily produced by maintaining too moist an atmosphere and too high a soil temperature.

POINT ROT. See *Blossom End Rot*, this section.

Root Knot

Eel Worm, Nematodes

Heterodera radicicola (Greef) Mull.

One of the common troubles on indoor tomatoes is caused by nematodes—small worms which inhabit the soil. They gain entrance to the young roots where a part of their development takes place. The presence of these minute worms in the tissue of the roots causes a reaction on the part of the cells, resulting in the formation of galls. On tomato roots many galls are formed which cut off the water supply and cause more or less injury to the crop.

Eel worms are very susceptible to treat-

* Cornell Bulletin 53. 1893.

ment by drying, freezing or excess of water, and high temperatures, and the methods of treatment are based upon our knowledge of the influence of these factors upon the organisms. Drying the soil has been employed in Europe on field crops and is very satisfactory when applied on a small scale in the greenhouse. Removing the soil and replacing it with new, or freezing it, is quite effective, and the so-called catch crop method has proved successful in some instances. The method consists in planting some crops like mustard or rape before the regular crop is planted, and when the galls are well formed the crop is dug up, and the roots exposed to the drying action of the sun, which kills the worms. By this method the females are captured and destroyed at the most advantageous time.

One of the most practical methods of ridding a house of eel worms, when the proper facilities are at hand, consists in sterilizing. With special appliances this can be done effectively at no great cost, and is on the whole the cheapest and best method of destroying this pest.

Where water is allowed to stand for some time in the soil it becomes destructive to eel worms.

G. E. Stone,
Massachusetts Bulletin 138.

Root Rot, Rosette, Damping-Off
Rhizoctonia sp.

Root root or rosette occurs frequently in greenhouses where tomatoes are grown following crops of lettuce. The fungus produces various effects which are commonly damping-off of the younger seedlings or collapse of the older ones; recently a basal constriction of the stem of mature plants is traced to Rhizoctonia. In this case wilting of plants results. It seems to be propagated under greenhouse conditions where much organic matter is used and calls for soil disinfection through steaming or formalin drench. In older plants the symptoms are a shortened development of the axis, giving effects similar to that in lettuce.

Rust. See *Leaf Blight*, this section.

Scab. See *Leaf Mould*, this section.

Sclerotium Blight

This is a wilt disease first reported by Rolfs from Florida but it is now general in greenhouses. The first symptom is wilting of the terminal portion of plant. The dead plants and diseased portions show in them sclerotia of the fungus which causes the trouble. These are of the size of mustard seed or smaller, at first milk white and finally mahogany red to black. Sometimes these sclerotia grow together in anvil-shaped masses. Burning diseased plants is advised.

A. D. Selby,
Ohio Bulletin 214.

Sleeping Diseases. See *Wilt*, this section.

Summer Blight. See *Wilt*, this section.

Surface Molds
White Fly Excretions

Tomatoes under glass suffer to a considerable extent from the excretions of the greenhouse white fly *(Aleyrodes)*. When this fly becomes abundant and is allowed to thrive in the house the plants become coated with a sticky substance (honey dew), which forms a favorable medium for the development of surface molds. The remedy is to destroy the flies. Hydrocyanic acid gas is recommended and the following formula has been used with success.

Ten gms. fused cyanide of potassium (98-99% pure), 20 c.c. commercial sulphuric acid; 40 c.c. of water to 1,000 cubic feet of space.

Turn the acid into the water in an earthen or graniteware jar and then, by a loose bag and string, drop the cyanide in, after tightly closing the place to be fumigated.

Fumigate every two weeks as long as the fly is present. Cyanide of potassium is a virulent poison and the house should be thoroughly aired before it is re-entered.

Timber Rot
Sclerotinia libertiana Fckl.

The fungus causing what is termed "timber rot" is occasionally found on tomatoes, and the effects are similar to

those produced by the stem rot of cucumbers. Tomatoes, however, are not as susceptible to timber rot as cucumbers, although when affected the crop is greatly injured. We have repeatedly grown crops of tomatoes in soil badly infected with the timber rot fungus but as a rule only a few plants become diseased, and from this it would appear that tomatoes are generally immune to attacks from Sclerotinia.

Sclerotinia is a sterile soil fungus, and gains entrance to the plant near the surface of the soil. When the plant becomes infected the fungus traverses the stem and breaks out some distance above the ground, the part of the stem affected becoming whitish in appearance. Small, hard, black masses called sclerotia, about one-thirty-second or more of an inch in diameter, make their appearance on the surface of the stem. These sclerotia are capable of throwing out filaments, or germinating and affecting other plants. Drying the soil greatly increases the activity, and infection of succeeding crops is thereby materially increased.

Control

Since the disease has not proved to be of great importance on tomatoes in Northern greenhouses, remedial measures are not urgently needed; but should it ever become so, soil sterilization will be found efficacious, and the treatment of the soil with formalin may prove valuable.

G. E. Stone,
Massachusetts Bulletin 138.

Western Tomato Blight

F. D. Bailey

This disease of tomatoes has, for some time, caused severe losses to growers and in certain sections has forced them to give up what would otherwise be a very profitable crop. It is apparently confined in distribution to the region of the Northwest known locally as the "Inland Empire." In Oregon it is serious only in the eastern sections of the state and westward along the Columbia river.

This disease is characterized by a gradual yellowing and curling of the foliage; as the leaf tissue turns yellow the veins take on a purplish color. The plants are dwarfed and fail to mature fruit. The stem of an affected plant is thickly covered with glandular hairs, the stain which they produce seeming to be much more abundant than from a healthy plant. The root systems of diseased plants are often very different from the normal healthy ones. The smaller lateral roots show the effect of some organism. They are at first discolored and finally die back. Where such a root is killed, several more start at its base from the main root to replace it. These are often killed and the same thing happens again, so that a cluster or mat of short laterals is produced instead of the long normal feeding roots. This condition has led to an investigation for the presence of a fungus which attacks the roots from the soil.

Investigations have been carried on for some time at the Washington State Experiment Station, where Professor H. B. Humphrey has succeeded in proving that the causal fungus is a species of a common soil organism. This fungus is a difficult one to combat. There are several further experiments to be tried toward this end. So far the following courses are recommended:

Treatment

The work at the Pullman station seems to show that the most help along control lines at present can be obtained if the seed bed is done away with. The seed should be planted four to a hill and in hills three or four feet apart in the field. Individual forcing boxes should be used, if practical, until the plants are five or six inches high. After removing these, thin the plants so as to have one to a hill.

The experiments where this method was tried showed a very small percentage of blight as against varying losses where checks were kept by setting plants from seed beds. The difference probably is due to the fact that the roots are injured in transplanting, thus furnishing the fungus an opportunity to enter.

Resistant Strain

Another course which may well be pur-

sued is the development of a resistant strain. The grower first selects several desirable varieties. These are planted where it is known that the disease has appeared previously, and from any plants that mature fruit, seed is saved. Mark especially any plants that show resistance to the wilt and take the seed from several tomatoes on such plants. The following season this method is followed out again, using the seed saved from the seemingly resistant plants. After several years of careful selecting, a strain should be obtained which will retain the character of resistance.

White Mold

Eriophyes calacladophora

This is a disease of the tomato characterized by general fuzziness. In its first stages it may be recognized from the following description by P. H. Rolfs:

If one is standing in a tomato field shortly after sunrise, or near sunset, and looking across the field in the direction of the sun, the plants which are attacked will be easily distinguished from the others in the field by a peculiar white, fuzzzy appearance of the upper portion of the stem.

In spite of its name "mold," it is not caused by a fungus parasite, but, as was determined by P. H. Rolfs in 1892, by a small mite, closely related to the rust mite of citrus. This mite is almost peculiar to Florida, although it occurs as far north as South Carolina.

The remedy is the same as for its close relative, the mite of citrus; that is, sulphur. In this case the sulphur is best used as a spray, which must be thoroughly applied.

Caustic soda (98 per cent), 10 pounds; flowers of sulphur, 20 pounds; water, 20 gallons.

Mix the sulphur in cold water to a thick paste, add the soda, and as it boils add water gradually to make 20 gallons. This water should be added fast enough to prevent burning, but not fast enough to stop boiling. The result will be a dark coffee-colored liquid. Strain through a fine-meshed cloth or spray-strainer. Keep in tightly-corked jugs. Mix one-half gallon of this stock solution in 40 gallons of water when ready to use. Other good remedies are: lime-sulphur solution, dry sulphur and dry sulphur and lime.

J. R. WATSON,
Florida Bulletin 112.

Wilt or Summer Blight

F. D. BAILEY

This disease is very much like the Western tomato blight in many respects, but should not be confused with it. It is described as occurring throughout California, and, in some instances, causing a total loss of the plants in a field.

In Oregon occasional reports, of what is quite certainly this disease, have come from the southern part of the state.

Symptoms

The trouble makes its appearance in the early summer. Often the plants are quite large and fruit is set before the disease begins to appear. Scattering plants through the field are the first to appear sickly; these gradually fall behind the rest in growth, take on an unhealthy color and finally wilt. The wilting is at first noticeable during the hot part of the day only, but as the disease progresses, the plant finally collapses entirely. This condition may continue to spread through the summer until very few or no plants are left.

Cause

The cause of this disease is a species of Fusarium, a common soil fungus. This fungus attacks the roots from below the surface of the soil and causes a root rot. It also enters the conductive tissues of the plant, where it spreads and plugs the vessels so that the water supply is prevented from reaching the top, and as a result the plant wilts.

Treatment

As regards control measures little of value can be recommended. In some cases it may be advisable to sterilize the soil in the seed beds in regions where the trouble is prevalent. This method would not generally prove practical, however, and the use of new land, when possible, is to be preferred.

There is more hope in combating this disease by the development of resistant strains or races. While this is a slow process, it has proven satisfactory where similar diseases have occurred in other plants. (See *Western Tomato Blight* for method to employ.)

Wilt, "Sleeping Disease"

Fusarium lycopersici Sacc.

The symptoms of this wilt are rather characteristic. It may attack plants either vigorous or of slow development. Commonly the first symptom noticed is the yellowing and drying up of the lower leaves. Soon dark areas appear in the stem and also in the fruits. At all stages cross sections show darkening of vessels. The roots become darkened and watery in the region of the vessels. Eventually the top of the plant wilts and the leaves die both above and below, while the fruit has become worthless. This is a soil-infesting disease that should be controlled by thorough soil sterilization.

A. D. Selby,
Ohio Bulletin 214.

Winter Blight of Tomato

Winter blight occurs on the winter shipping crop or in early spring plants. The leaves and stems are blackened and killed and spots appear on the fruit causing it to soon decay. Bordeaux mixture 5-5-50 formula, sprayed on the plants following a rain holds the disease in check. The late blight of the potato is also caused by this disease.

Tomato Diseases—Bibliography

Western Tomato Blight

None.

Wilt

1906. California Experiment Station Bulletin 175.

1912. Tennessee Experiment Station Bulletin 95.

Blight

1906. California Experiment Station Bulletin 175.

1911. Virginia Experiment Station Bulletin Polytechnic Institute 192.

(Also see *Late Blight of Potato.*)

Leaf Mold

1898. Florida Experiment Station Bulletin 47.

Point Rot

1907. Massachusetts Experiment Station Technical Bulletin 3.

1911. Georgia Experiment Station Bulletin 96.

TOMATO PESTS

Blister Beetles

Epicauta sp.

These insects, also known as "Spanish flies," or "old-fashioned potato bugs," sometimes become sufficiently numerous to strip the leaves from quite an area of their favorite foods, such as tomato, potato, beet and tobacco. The adults move in large companies, which can strip a number of plants in a few hours. It is only the adult beetles that injure vegetation. The young feed either on the honey and eggs of wild bees, or on the eggs of grasshoppers, in which latter event they do much good. In view of this fact, it is probably as well to make no very strenuous attempt to destroy them unless they occur in such excessive hordes as to threaten serious damage.

The best remedy is probably lead arsenate, or zinc arsenite. The spraying should be done very thoroughly, so as to cover every portion of the plants in order to discourage feeding. The beetles take fright readily, and an old remedy is to drive them from a small patch by means of leafy branches, brooms or switches.

J. R. Watson,
Florida Bulletin 112.

Boll Worm. See *Tomato Fruit Worm*, this section.

Bugs

In common with many other plants, the tomato suffers from the attacks of a number of bugs which suck the juices of the plant. Among them are the green soldier bug, or pumpkin bug (*Nezara hilaris*), the stink bug (*Euschistus variolarius*), and the leaf-footed plant bug (*Leptoglossus phyllopus*).

Kerosene emulsion, or tobacco decoction, will prove effective against the young nymphs, and it is at this stage that they

should receive the attention of the grower. When they have become adults it is rather more difficult to kill them. Then hand picking, or knocking them off into a pan of kerosene in the early morning or on cool days when they are sluggish, is about the only practical method of dealing with them.

Besides these larger bugs, tomato plants are often attacked by a number of smaller, more delicate bugs. Among them may be mentioned the tarnished plant bug, a greenish-brown insect about one-fourth of an inch long; the sharpshooters, and the leaf hoppers. One of the latter is the "destructive leaf hopper" (*Cicadula*), a brownish bug about one-fifth of an inch long. This lays its eggs in the tender branches, causing them to wilt. These wilting branches may be destroyed with the contained eggs. The tobacco sprays will prove effective against any of these smaller bugs even in the adult stage.

Colorado Potato Beetle

Leptinotarsa decemlineata

Occasionally attacks tomatoes. The best remedy, if the beetles become serious, is a solution of lead arsenate, one pound to from seven to ten gallons of water. Where they are but few, hand picking will prove to be more practical.

J. R. Watson

See also *Colorado Potato Beetle* under *Potato Pests*.

Corn-Ear Worm. See *Tomato Fruit Worm*, this section.

Cutworms

Many species, but all naked larvae of the *Noctuid* family of moths.

Remedies to Use

Spray grass or weeds with poison on ground in preparation for cultivation several days before plowing; or scatter over the ground before planting a poisoned bran mash made as follows:

Use one-half pound of sugar or molasses per gallon of water, and use enough of such sweetened water to dampen 50 pounds of bran. Now add one-half pound of Paris green or white arsenic by sprinkling lightly over the surface of the bran, while vigorously stirring so as to mix the poison uniformly through the mass. Vegetables already planted may be protected by a teaspoonful being placed near the base of the plant.

This poison keeps effective through a longer period if placed under boards or chips scattered through the garden. Another good poisoned bait is obtained by spraying clover or other succulent vegetables with poison, mowing the same and scattering it in fair-sized heaps over the infested ground. Make the piles large enough to prevent the under portion from quickly drying out.

Robins, blackbirds and bluebirds destroy many cutworms.

H. A. Gossard

Grasshoppers

Many species.

These attack tomatoes in common with other plants, and in occasional years there is an outbreak of a serious nature. In the tomato field the best method is probably one of the poison baits. The most successful is the following "Minnesota mixture:

Sodium arsenite (commercial), one pound; horse manure, 120 to 150 pounds; cheap molasses, one pint. The arsenite and molasses should be dissolved in enough water to moisten the mass.

It has been found that field crops may be protected and the grasshoppers killed by spraying with the following:

Commercial arsenite of soda, three pounds; molasses, one and one-half gallons; water, 180 gallons.

Green Soldier Bug. See *Bugs*, this section.

Leaf-footed Plant Bug. See *Bugs*, this section. Also under *Squash Pests*.

Leaf Hoppers. See *Bugs*, this section.

Potato Flea Beetle. See *Potato Pests*.

Pumpkin Bug. See *Bugs*, this section.

Semitropical Army Worm

Prodenia eridania

This insect is related to the cutworms. The fore wings are gray with brown markings, and the hind wings are pearly white.

The caterpillar has five longitudinal yellow stripes.

Spray with lead arsenate or zinc arsenite.

J. R. Watson

Sharpshooters. See *Bugs*, this section.

Solanum Mealy Bug. See *Potato Pests*.

Stink Bug. See *Bugs*, this section.

Sphinxes

Tobacco Sphinx

Phlegethontius quinquemaculata Haw.
(Family *Sphingidae*)

Protoparce quinquemaculata Haw.
Protoparce celeus Hubn.

General Appearance

All forms of this species greatly resemble those of the tomato worm in size and general appearance. The lateral oblique white stripes of the larvae do not extend as far up the back in the tobacco worm as in the tomato worm. There are also longitudinal white stripes below the spiracles, forming "Vs" with the oblique stripes. The horn at the tip of the body is black. The chrysalis has a much longer tongue case in this species than has that of the tomato worm. The adults are about the same size, this species being duller and with less distinct white markings. The abdomen is more pointed; the spots are lighter orange in color and two less in number than in the tomato sphinx.

Fig. 1. The Tobacco Sphinx (*Phlegethontius quinquemaculata* Haw.) at Left and the Tomato Sphinx (*Phlegethontius sexta* Johan.) at Right. The chrysalis and larva are of the tobacco sphinx. (Original.)

Food Plants

The principal food plants of this insect are tobacco and tomato, though they feed upon various varieties of the Solanaceae.

Natural Enemies

Internal parasites prey upon the larvae and greatly aid in keeping down the numbers.

White-Lined Sphinx or Morning Sphinx. See page 755.

Tomato Sphinx

Phlegethontius sexta Johan.
(Family *Sphingidae*)
Protoparce sexta Johan.
Protoparce carolina Linn.

General Appearance

The larvae of this moth are exceedingly large, often attaining a length of nearly four inches. They are green in color with showy, oblique white stripes, and highly colored spiracles along the side. They always have the characteristic curved spine on the last segment, which is red in this species. The chrysalis is rich brown and nearly two inches long. The adults are two inches long, having a wing expanse of from four to five inches. The general color is gray with orange or yellow spots on each side of the abdomen.

Distribution

Exceedingly common.

Food Plants

The larvae work largely upon tomato plants, often defoliating large areas. They also attack potato, tobacco and various Solanaceae.

Natural Enemies

Internal parasites perform an important part in the control of this pest and are responsible for the comparatively small amount of damage done.

E. O. Essig

Suck Fly

Dicyphus minimus Uhler

This small bug which is a serious pest of tobacco, occasionally attacks tomatoes and eggplants in the early fall.

The adult is about one-eighth of an inch in length. Quaintance found that a strong tobacco infusion was the best

remedy. One pound of tobacco to every gallon of water was found necessary to kill them.

Boil thoroughly for an hour, and strain. The decoction will keep two or three days only. Here, as elsewhere, clean culture is one of the best preventives. Clean up and burn all plants of both tobacco and tomato as soon as the crop is harvested.

TARNISHED PLANT BUG. See *Strawberry Pests*, also *Bugs*, this section.

Tomato Aphis

Megoura solani Thomas

For method of control, see general article on *Aphids*.

Tomato, Corn-Ear Worm or Cotton-Boll Worm

Heliothis obsoleta Fab.
(Family *Noctuidae*)
Heliothis armiger Hubn.

General Appearance

The adult moths are day as well as night flyers and are exceedingly common. They are nearly one inch long and grayish or brownish in color, with or without markings upon the fore wings. The eggs are dirty yellowish-white in color. The larvae are nearly two inches long when full-grown and vary from yellowish to brownish in color with longitudinal gray and white stripes and with eight dark spots or tubercles on each segment. The pupae are rich brown.

Distribution

Exceedingly common.

Food Plants

This species is perhaps most commonly known as the corn-ear worm from its attacks upon the ears of sweet corn. The larvae enter near the silk end and destroy either the tip or the whole ear. The damage done is often enormous. The fruit of the tomato is also attacked, the worm eating large holes into the bottoms or sides and thus causing decay. In the Southern states this species works upon the cotton bolls and is there known as the cotton-boll worm.

Control

The control of this pest is somewhat more complicated than in the case of the ordinary cutworms, due to the fact that the young worms work in the ear of the corn, in the tomato or cotton boll and are thoroughly protected from external remedies. The use of early-ripening varieties as well as a trap crop is highly recommended. Spraying the young ears, tomatoes, or bolls with poisoned sprays gives relief if the work is done thoroughly and often, but it must be begun before the worms are inside.

White Fly of Tomato

Aleurodes tabaci

This relative of the too well-known citrus white fly occasionally attacks tomatoes. Kerosene emulsion is recommended, as well as destruction of badly infested vines.

J. R. WATSON

TOOLS. See *Apple Orchard, Cultivation of.*

TOP-WORKING. See *Apple, Propagation*, p. 125.

TORINGO APPLE. See *Apple, Botany of.*

TOWNSHEND, J. K. See *History of Orcharding in Old Oregon.*

TRANSPORTATION OF NURSERY STOCK. See *Laws.*

TRACING MOVEMENTS OF CARS. See *Reduction of Waste in Marketing*, under *Marketing.*

TREES, WHERE TO BUY. See *Apple*, p. 135.

TREE ROOTS. See *Root System.*

Turnip

The word turnip is defined as "the fleshy, globular, edible root of a biennial plant of the mustard family; also the plant." The roots are boiled and served as a vegetable in various ways, and also fed to domestic stock The tender growing tops are also gathered in the spring, and cooked as greens. The turnip is grown generally in autumn; and while it is sometimes grown in early spring, the seed is sown mostly in August, or September, depending on the latitude and climate, and grown during the cool weather of autumn, reaching its highest development in the later part of the season, just before the ground freezes. During the first

year of its growth, the root is formed, and if allowed to remain in the ground during the winter, or taken from the soil and stored, then transplanted in the spring, the second year will form a long branched stem, bearing bright yellow flowers, which form the seeds for sowing the following year.

Varieties

The varieties of turnip are generally classified according to their shape.

First: The long varieties with a root three or more times as long as the breadth.

Second. Spindle-shaped varieties, with a root about twice as long as the breadth.

Third: Round or globe varieties with an almost spherical root.

Fourth: Flat varieties with a root broader than long.

There are also many intermediate forms. Turnips may also be grouped according to the color of the upper part of the root which comes above the ground, and according to the color of the flesh, which is white or yellow. The yellow-fleshed varieties, many of which are probably hybrids between the turnip and the Swede, are more robust, hardy, of slower growth, more nutritious and of superior feeding qualities. This variety is also less injured by frost than the white turnip.

The Swede turnip differs from the turnip proper in having the first foliage leaves of a pale bluish-green color, sometimes called sea green, and covered with a bluish-white bloom; rather than the grass green of the ordinary turnip. The root of the Swede also bears a distinct neck with well-marked leaf scars, the flesh is yellow or reddish orange, firmer and keeps better during the winter.

Rutabaga is another name for the Swede turnip. It is grown in the same manner as the common turnip, except that it is of slower growth and should be planted about a month earlier, say about the last of June, or the first of July.

Cultivation

The turnip should be grown in rich rather sandy loam. It is not best that the soil should be heavily fertilized with barnyard manure, on account of the tendency to attack from worms. A new soil is good, or a soil recently in pasture, or meadow, or a soil rich in potash. To be of the best quality, the turnip should grow rapidly. The seed is very small, and in sowing is generally mixed with some fine substance like dust, or ashes. It may be sown broadcast, or in drills and thinned to the proper distances. Often turnips grown for use late in the season are grown on ground where an early crop has been harvested, such as early potatoes, early cabbages, wheat, rye or early corn. In this manner the ground may be used for the growing of two crops in one season.

Granville Lowther

TURNIP DISEASES AND PESTS

Turnips are attacked by the same diseases and pests as other *cruciferae*. See *Cabbage, Mustard, Cauliflower, etc.*

Turnips, How Grown in Alaska. See *Alaska.*

Turnips and Rape for Cover Crops. See *Apple Orchard Cover Crops.*

Utah

Utah was named after the Ute tribe of Indians. It contains 84,000 square miles. Running north and south through the state are mountain ranges, the principal of which is the Wasatch range, termed the "Backbone of the State."

The Green and Grand rivers drain the territory east of this range. In the western part of the state is a range of mountains that is a part of the Sierra Nevadas. Between these two ranges, one on the east and one on the west, is a great basin in which is situated the Great Salt Lake, sometimes called the "Dead Sea of America," and Utah lake about 40 miles southward from Salt lake.

The annual rainfall is only about 10½ inches per annum, and little can be grown without irrigation.

Cache valley in the Wasatch range is a fruit-growing section about 60 miles long and from 12 to 18 miles wide, but the dif-

ficulty here is that only a small proportion of it can be irrigated.

In the northern portion of the state there is much danger from frosts, except where the land is protected by air drainage, usually by what is called canyon winds, which begin blowing about eight o'clock in the evening and blow with almost absolute regularity all night. These winds are so strong as to make necessary wind breaks to protect the trees.

In Washington county in the southwestern part of the state there is a section where the climate is mild, the air drainage good, and where all kinds of fruits common to northern climates can be successfully grown.

GRANVILLE LOWTHER

Production of Vegetables and Fruits in Utah

Vegetables, flowers and plants, and nursery products: 1909 and 1899. The table which follows shows details with regard to vegetables, not including potatoes and sweet potatoes and yams, and also with regard to flowers and plants and nursery products:

CROP	Farms reporting, 1909		Acres		Value of Products	
	Number	Per cent of all farms	1909	1899	1909	1899
Vegetables, other than potatoes and sweet potatoes and yams, total	[1] 9,046	41.7	7,006	6,023	$717,776	$396,099
Farms reporting a product of $500 or over	256	1.2	1,630	....	225,613	....
All other farms	8,790	40.6	5,376	....	492,163	....
Flowers and plants, total	33	0.2	20	14	81,116	34,173
Farms reporting a product of $250 or over	25	0.1	....	....	79,914	....
All other farms	8	(2)	....	....	1,202	....
Nursery products, total	38	0.2	577	236	188,455	120,648
Farms reporting a product of $250 or over	15	0.1	....	....	185,832	....
All other farms	23	0.1	....	....	2,623	....

[1] Does not include 1,996 farms which reported that they had vegetable gardens, but gave no information as to their products.
[2] Less than one-tenth of 1 per cent.

In 1909 the total acreage of potatoes and other vegetables was 21,216 and their value $1,591,847. Excluding (so far as reported separately*) potatoes and sweet potatoes and yams, the acreage of vegetables was 7,006 and their value $718,000, both acreage and value being materially greater than in 1899. The table distinguishes between farms which make the raising of vegetables a business of some importance (having produced vegetables valued at $500 or more in 1909) and other farms, on most of which vegetables are raised mainly for home consumption. There were in 1909 only 256 farms in the first class, representing nearly one-fourth of the total acreage of vegetables and nearly one-third of the total value, the average acreage of vegetables per farm for these farms being 6.4 and the average value of product per acre $138.41.

The raising of flowers and plants and of nursery products was also of some importance in Utah, for, while only 597 acres were devoted to it in 1909, the output was valued at $269,571. Most of the product was raised on farms where these branches of agriculture were carried on as an important business.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quan-

* It is probable that some of the potatoes and sweet potatoes and yams raised in farm gardens were not reported separately by farmers, but were included in their returns for vegetables.

tity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total		1,416	1,052	3,118,395	$217,327
Strawberries	1,049	719	345	1,832,796	125,854
Blackberries and dewberries	247	95	72	184,140	13,447
Raspberries and loganberries	1,291	374	284	758,317	54,826
Currants	1,043	128	194	195,901	13,435
Gooseberries	851	100	110	147,241	9,765
Other berries			47		

Strawberries are by far the most important of the small fruits raised in Utah, with raspberries and loganberries ranking next. The acreage of small fruits in 1909 was 1,416 and in 1899, 1,052, an increase of 34.6 per cent. The production in 1909 was 3,118,000 quarts, as compared with 1,695,000 quarts in 1899, and the value $217,000, as compared with $117,000.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total		1,385,681		1,641,755	633,739	$640,904	397,863
Apples	8,419	517,039	4,631	789,260	350,023	319,691	189,882
Peaches and nectarines	4,765	544,314	2,856	651,233	143,237	156,451	85,315
Pears	4,747	79,355	1,642	39,901	38,654	44,365	59,982
Plums and prunes	5,771	135,619	1,616	23,388	68,249	54,040	45,984
Cherries	4,244	79,775	2,300	109,119	21,402	54,170	9,905
Apricots	2,760	28,978	1,101	28,639	12,047	12,037	5,272
Quinces	134	597	48	215	118	135	(2)
Mulberries	1	4			9	15	(2)
Unclassified							[3] 1,523
Grapes	692	204,445	277	94,043	1,576,363	28,126	920,000
Nuts, total		[4] 1,737		[4] 1,160	16,649	1,547	9,110
Persian or English walnuts	53	292	42	484	5,985	533	1,310
Almonds	113	1,408	39	664	10,664	1,014	7,600
Unclassified							[3] 200
Tropical Fruits, total		387		175		588	
Figs	46	287	16	175	22,164	576	5,425
Pomegranates	1	100			400	12	

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and tropical fruits.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes hickory nuts, chestnuts and pecans.

The total quantity of orchard fruits produced in 1909 was 634,000 bushels, valued at $641,000. Apples contributed considerably more than one-half of this quantity, and peaches and nectarines ranked next in importance. The production of grapes in 1909 was 1,576,363 pounds, valued at $28,126; there was also a small production of nuts and of tropical fruits.

The production of all orchard fruits together in 1909 was 59.3 per cent more in quantity than in 1899, and that of grapes also increased. The value of or-

chard fruits increased from $263,000 in 1899 to $641,000 in 1909, and that of grapes from $27,736 in 1899 to $28,126 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The next table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	65	0.3	Gals.	5,347	13,828
Vinegar	92	0.4	Gals.	2,689	6,111
Wine and grape juice	50	0.2	Gals.	12,173	16,804
Raisins and dried grapes	66	0.3	Lbs.	32,245	145,380
Other dried fruits	240	1.1	Lbs.	71,498	

Frost and Precipitation in Utah

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Snowville	Sept. 26	June 18	Sept. 7	July	10.6
Logan	Oct. 2	May 11	Sept. 4	June 16	14.1
Salt Lake City	Oct. 18	April 23	Sept. 22	June 18	15.8
Provo City	Sept. 21	May 13	Sept. 9	June 2	10.9
Vernal	Oct. 3	May 4	Sept. 18	May 21	8.4
Levan	Sept. 30	May 20	Sept. 12	Nov. 1	15.2
Fillmore	Sept. 20	May 16	Aug. 23	June 14	14.5
Loa	Aug. 13	June 23	....	....	6.6
Moab	Oct. 2	April 22	Sept. 13	May 4	7.5
Modena	....	....	Sept. 12	May 24	7.1
Hite	....	....	....	....	2.3
St. George	Oct. 7	May 3	Sept. 25	May 24	6.6

Value of Important Crops. See under *Farms*.

Varieties of Apples Propagated. See *Apple Industry, Present Status of*. p. 79.

Vegetable Garden

The vegetable garden is one of the important features of farm life. Even under circumstances where no vegetables are sold in the markets, and where they are grown simply for home use, the garden adds greatly to the varieties of foods and to the health and the economy of living. In the suburbs of towns and cities, as well as in the country the vegetable garden is often an important part of the family food supply. On a few square rods of land, well fertilized, well watered and well cultivated more can be added to the family income than most people imagine.

Vegetables in the Orchard

In an orchard district, where the trees are not yet in bearing, the land between the trees may often be utilized for the growing of vegetables for commercial purposes, until such time as the trees shade the ground so that vegetables cannot be successfully grown. This method does

not hinder the growth of the trees nor in the least injure them, provided as many tons of barnyard manure is placed upon the land as there are tons of vegetables removed. In some cases where the land is naturally fertile, this may not be necessary, but in most cases this rule will apply.

Much depends on the circumstances under which orchards are grown as to whether inter-cropping pays, or to what extent it will pay; but more depends on the man, the intelligence with which he chooses the varieties, the cultivation and last but not least, the marketing.

Management

After all the crops are harvested the ground should be plowed. After it is plowed then it should be manured. Some people would manure it before the fall plowing, but our objection to this is that when the land is plowed again in the spring the manure that was plowed under the previous autumn will be turned back and be on the surface after the spring plowing, while if it is placed on the land after the fall plowing and allowed to remain during the winter the rains and the snows will leach the soluble substances down into the soil, and the following spring when the early plowing is done this manure will be turned under and will be a few inches below the surface, where it will more readily decay, and from which position the roots of the growing crops will draw their food. Ground should not be plowed when it is too wet, for the stirring of wet land tends to pack the soil, and when it dries it becomes cloddy.

In the autumn bulbs should be covered with leaves, straw or litter to a depth of two or three inches to protect them from freezing. The old stalks of asparagus should be cut and burned and the bed covered with barnyard manure about three inches deep. In the autumn the seed should be selected for the following year, and the best and most perfect specimens of all products should be chosen for seed.

In the selection of potatoes for seed many people think that it is not important to select the best specimens. They plant the small unmarketable potatoes, thinking that they will produce as good a crop as if the best were selected; but the opinion of experts in the government stations and in the state agricultural colleges is against this idea. They advise planting perfect specimens of potatoes in order to get the best results.

Rhubarb requires a rich, mellow soil, which should be deeply plowed and well fertilized.

Certain kinds of vegetables will mix by the carrying of pollen from one to another if planted side by side at such times as the pollen will form at the same period. For instance, if summer squashes and pumpkins are planted near together about the same time, the bees will carry the pollen from one to the other and there will be a mixture of the two varieties. Field corn, popcorn and sweet corn will mix in the same way.

GRANVILLE LOWTHER

COMMON VEGETABLES

The different species of vegetables commonly grown for home use and commercial purposes are listed here:

Anise, artichokes, asparagus, beans, beets, Brussels sprouts, cabbage, caraway, carrots, cauliflower, celery, celeriac, coriander, corn, cress, cucumber, dill, eggplant, endive, fennel, garlic, gourd, greens, horseradish, kale or broccoli, kohlrabi, leeks, lettuce, melons; (1) muskmelon, (2) watermelon; okra, onions, oyster plant or salsify, parsnip, parsley, peas, peppers, potatoes: (1) Irish, (2) sweet; pumpkins, radishes, rhubarb, rutabaga, salsify or oyster plant, spinach or spinage, squash, tomatoes, turnips, watercress.

CLASSIFICATION OF VEGETABLES

Samuel B. Green classifies vegetables as follows:

Vegetables may be classified in many ways, but perhaps the most helpful way is to divide them according to the conditions under which they grow best into (1) warm and (2) cold climate vegetables:

(1) Among warm climate vegetables (often called tropical) we have tomato, corn, beans, pepper, eggplant, cucumber, musk melon, watermelon, squash, pumpkin and okra. These plants all require hot weather for their growth, are severely injured by first hard frost, and should not be planted in open ground until warm weather is assured. They are generally at their best on a warm southern exposure and in soil having a little sand in its composition. These plants are all natives of hot climates and will not survive long in cold climates when left to themselves.

(2) Among cold climate vegetables, we have practically all those commonly grown not mentioned above, (1) such as asparagus, rhubarb, horseradish, salsify and parsnip, which stand our severest winters without injury; and those that are less hardy, such as onions, leeks, peas, beets, spinach, cabbage, Brussels sprouts, cauliflower, cress, kale, kohlrabi, radishes, rutabaga, turnip, carrot, parsley, celery, celeriac, lettuce, endive, potato, tomato and others. These all grow well at a cool temperature and most of them will stand some frost without injury. They may be divided into those with tops that are frost hardy or frost tender as follows:

By frost tender is meant those whose tops are injured by a light frost, such as potato, asparagus, strawberry, tomato, and of course all the tropical plants mentioned above (1). Some plants like asparagus and our native oak trees may have foliage that is very susceptible to frost but are hardy in winter.

By frost hardy is meant those having foliage that is not injured by light frost, such as horseradish, rhubarb, onions, leeks, garlic, peas, spinach, beets, cabbage, Brussels sprouts, cauliflower, cress, kale, kohlrabi, radishes, rutabaga, turnip, carrot, parsley, celery, lettuce, endive and most of the garden herbs.

Botanical Classification

All plants may be divided into families, each of which has its distinguishing features. Our garden vegetables and herbs belong to at least 17 families, the special features of each of which will be found with the cultural directions for the plants grouped under them; but for convenience a list is here given, arranged under their proper family names:

Fungi Group or Family

Mushrooms or toadstools.

Grass Family

Gramineae

Corn.

Lily Family

Lilliaceae

Asparagus, onion, leeks, garlic.

Buckwheat Family

Polygonaceae

Rhubarb or pie-plant.

Goosefoot Family

Chenopodiaceae

Beet, Swiss chard and spinach.

Cabbage Family

Cruciferae

Cabbage, cauliflower, radishes, rutabaga, turnip, Brussels sprouts, kale, kohlrabi, horseradish, cress and watercress.

Clover Family

Leguminosae

Beans, peas and pulse.

Mallow Family

Malvaceae

Okra.

Parsnip Family

Umbelliferae

Parsnip, parsley, carrot, celery, celeriac, caraway, dill, anise, coriander and fennel.

Morning Glory Family

Convolvulaceae

Sweet potato.

Mint Family

Labiatae

Sweet basil, lavender, balm, spearmint, peppermint, summer savory, winter savory, sweet marjoram, thyme, sage and catnip.

Potato Family

Solanaceae

Tomato, potato, eggplant, peppers and strawberry tomato.

Martynia Family

Martiniaceae

Martynia.

Gourd Family

Cucurbitaceae

Cucumber, squash, muskmelons, watermelons, pumpkin and gourd.

Sunflower Family

Compositae

Lettuce, salsify, endive and dandelion.

Rue Family

Rutacea

Rue.

Borage Family

Boraginacea

Borage.

Suggestive Plan for Home Garden

Any good farmer or gardener can make a plan for a home garden that will suit his circumstances better than anything we can suggest; but we submit the following, by P. F. Williams, Alabama Experiment Station:

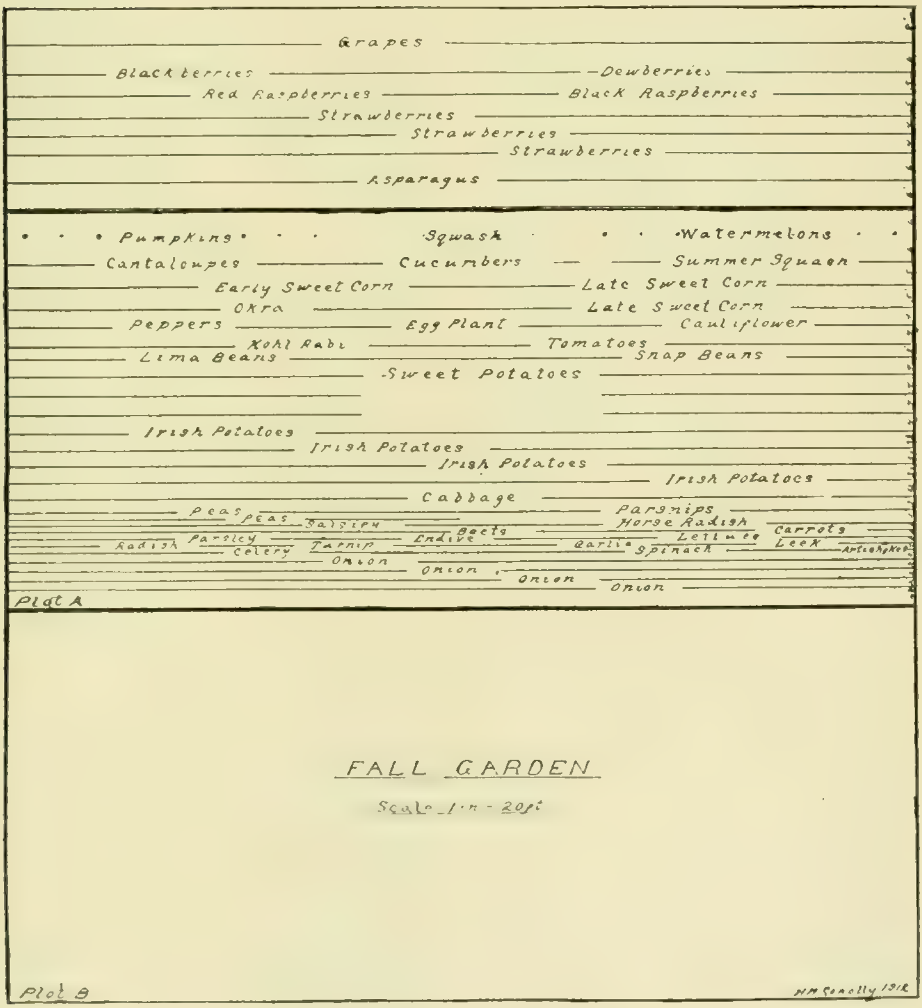


Fig. 1. Plan for a Home Garden

Farmer's Vegetable Garden

Another plan is presented by W. H. Wicks, of Moscow, Idaho. The suggestion provides for a plot 290 feet long by 75 feet wide, with the rows running lengthwise of the plot.

Varieties of Vegetables Planted

First Row. Conover's Colossal asparagus, one-half row; rhubarb, one-fourth row Myatt's Victoria, one-fourth row St. Martin's.

Second Row. Hollow crown parsnips, one-third row; Emerald parsley, one-third row; Sandwich Island Mammoth salsify, one-third row.

Third Row. Prizetaker onions, one-half row; large Rouen leek, one-fourth row; Australian Brown onion, one-fourth row.

Fourth Row. Golden Self-Blanching celery, one-half row; onions, one-half row.

Fifth Row. Onion sets, one-fourth row; Deacon lettuce, one-fourth row; Long Standing spinach, one-half row.

Sixth Row. Early potatoes, one row; radishes, one-fourth row each—French Breakfast, Celestial, Scarlet Turnip, New White Icicle.

Seventh Row. Peas, Nott's Excelsior.

Eighth Row. Crosby's Egyptian beets, one-fourth row; Blood Red beets, one-fourth row; Golden Ball carrots, one-half row.

Ninth Row. Late potatoes.

Tenth Row. Grand Rapids lettuce, one-fourth row; Giant Fringed Endive, one-half row; Improved Guernsey parsnips, one-fourth row.

Eleventh Row. Early York Cabbage, one-fourth row; Best Early cauliflower, one-fourth row; Fordhook Bush Lima beans, one-fourth row; "Burpee" Improved Bush Lima beans, one-fourth row.

Twelfth Row. Prosperity peas, one-third row; Horsford Early Market, one-third row; Telephone peas, one-third row.

Thirteenth Row. Extra Early Refugee beans.

Fourteenth Row. Bismarck Black Wax Prolific beans, one-half row; Dwarf Horticultural beans, one-half row.

Fifteenth Row. American Drumhead Savoy cabbage, one-half row; Tall Green Curled Scotch kale, one-half row.

Sixteenth Row. Burpee's Danish Prize Brussels sprouts, one-fourth row; Tabasco peppers, sixteen hills; Sweet Upright pepper, twenty hills; Early Freedom tomatoes, one-half row.

Seventeenth Row. Golden Bantam sweet corn, one-half row; Cory Early sweet corn, one-half row.

Eighteenth Row. Early Long Purple ggplant, one-half row; Spark's Earliana tomatoes, one-half row.

Nineteenth to Twenty-fourth Row. Burpee's Extra Early White Spine cucumber, 12 hills; Early White Bush summer squash, 10 hills; Hubbard squash, 12 hills; Small Sugar pumpkin, 12 hills; Cole's Early watermelon, 24 hills; Fordhook muskmelon, 26 hills.

NOTE.—Rows are three feet apart excepting the vine crops, which are six feet apart.

Composition of Vegetables

	Water	Ash	Nitrogen	Phosphoric Acid	Potash
	Per cent	Per cent	Per cent	Per cent	Per cent
Artichokes	81.50	0.99	0.36	0.17	0.48
Asparagus stems	93.96	0.67	0.29	0.08	0.29
Beans, Lima	68.46	1.69	......	......	......
Beans, string	87.23	0.76	...	...	...
Beets, red	88.47	1.04	0.24	*0.09	*0.44
Cabbages	90.52	1.40	0.38	*0.11	*0.43
Carrots	88.59	1.02	0.16	0.09	0.51
Cauliflower	90.82	0.81	0.13	0.16	0.36
Celery tubers	78.90	1.09	1.92	0.19	0.64
Celery, whole plant	78.33	1.02	......	......	......
Cucumbers	95.99	0.46	0.16	0.12	0.24
Eggplant	92.93	0.50	......	......	......
Horseradish, root	76.68	1.87	0.36	0.07	1.16

Composition of Vegetables—(Continued)

	Water	Ash	Nitrogen	Phosphoric Acid	Potash
	Per cent	Per cent	Per cent	Per cent	Per cent
Kohlrabi	91.08	1.27	0.48	0.27	0.43
Lettuce, leaves	86.28	1.71	....	....	....
Lettuce, stems	88.46	1.18	....	....	....
Lettuce, whole plant	93.68	1.61	0.23	*0 07	*0.37
Muskmelons, interior juice	92 61	1.01	....	....	....
Muskmelons, pulp	76 44	1.49	....	....	....
Muskmelons, pulp juice	90 53	0.56	....	....	....
Muskmelons, rind	91 15	0.68	....	....	....
Mustard, white	84.19	2.25	....	....	....
Okra	87.41	0.74	....	....	....
Onions	87.55	0.57	0.14	0.04	0.10
Parsnips	80.34	1.03	0.22	0.19	0 62
Peas, Canada field	12.48	2.36	....	....	....
Peas, Garden	12 62	3.11	3.58	0 84	1.01
Peas, green	79.93	0.78	....	....	....
Peas, small (Lathyrus sativus), whole plant	5 80	5 94	2.50	0.59	1.99
Pumpkins, flesh	93 39	0 67	....	....	....
Pumpkins, rind	86.23	1.36	....	....	....
Pumpkins, seeds and stringy matter	76.86	1.51	....	....	....
Pumpkins, whole fruit	92 27	0 63	*0.11	*0.16	*0 09
Rhubarb, roots	74.35	2.28	0.55	0.06	0.53
Rhubarb, stems	92 67	0 94	....	....	....
Rhubarb, stems and leaves	91 67	1.72	0 13	0.02	0.36
Rutabagas	88.61	1.15	0.19	0.12	0.49
Spinach	92.42	1 94	0.49	0.16	0.27
Squashes, flesh	88.09	1.72	....	....	....
Squashes, rind	82 00	1.21	....	....	....
Squashes, seeds and stringy matter	74.03	1 39	....	....	....
Squashes, whole fruit	94.88	0.41	....	....	....
Sweet corn, cobs	80 10	0 59	0 21	0.05	0.22
Sweet corn, husks	86.19	0.56	0.18	0.07	0 22
Sweet corn, kernels	82.14	0 56	0.46	0 07	0.24
Sweet corn, stalks	80 86	1 25	0.28	0 14	0 41
Sweet potatoes, tubers	71.26	1 00	*0.24	*0.08	*0.37
Sweet potatoes, vines	41 55	5.79	....	....	....
Tomatoes, fruit†	93 64	0.47	0 16	0.05	0.27
Tomatoes, roots	73 31	11.72	0.24	0.06	0.29
Tomatoes, vines	83 61	3.00	0 32	0 07	0.50
Turnips	90.46	0.80	0.18	0.10	0.39
Watermelons, juice	93 05	0 20	....	....	....
Watermelons, pulp	91 87	0 33	....	....	....
Watermelons, rind	89 97	1.24	....	....	....
Watermelons, seeds	48 37	1.34	....	....	....

†Sugar in fruit, 3 05 per cent; acid (malic), 0.46 per cent. *Wolff.
‡Compiled by office of Experiment Station.

VEGETABLE IVORY

The plant known in commerce as vegetable ivory is classed by botanists as *Phytelephas macrocarpa.* It is a native of South and Central America, growing chiefly on the banks of the river Magdalena, and Colombia. It is a palm, which yields a hard, fine-grained white substance which is the reserve cellulose stored in the cell walls of the fruits. Its stem reclines upon the ground for a few feet, and then is crowned with long, linear, plume-like pinate leaves, arching upwards for 20 or 30 feet. Its fruits lie near the ground, are globular, about as large as a man's head, and consist of several drupes enclosed in a woody, wart-covered wall. The kernels of the drupes or seeds are about as large as hens' eggs, and when very young contain a clear, insipid fluid, which is used by travelers instead of water. As in the case of the cocoanut, this fluid becomes milky and sweet flavored, and the nuts are eagerly eaten at this stage by animals; but they continue to thicken and harden until, when fully ripe, the seeds are so very hard as to form a valuable substitute for elephant ivory.

It is mostly found in separate groves, not mixed with other trees or shrubs, for it seems to grow where scarcely anything else can grow. It is known by the natives on the banks of the Magdalena as Tagau, on the coast of Darien as Anta, and in Peru as Homero.

Granville Lowther

Vermont

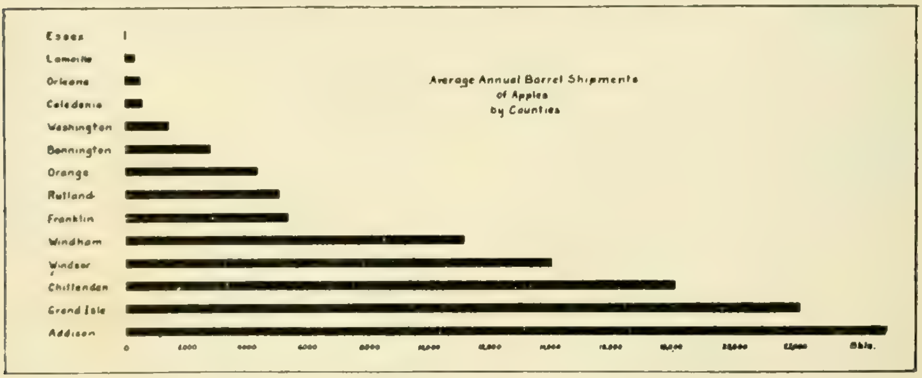
Like most of the New England uplands, Vermont is a portion of a plateau which rises about 1,000 feet above the sea and is broken by narrow valleys, high hills, mountain ranges and peaks. The principal mountains of Vermont are the Green mountains, extending north and south almost through the center of the state, and the Granitic mountains, of less size and altitude, along the eastern border. The drainage system on the east is toward the Connecticut river, toward Lake Champlain in the northeast, and toward the Hudson river on the southeast.

For the most part the soil of Vermont is a glacial drift, varying greatly in depth, and composed of clay, sand and gravel in the valleys, where it is very productive. Among the uplands, hills and mountains it is rough, stony and sterile.

The principal fruit is the apple. The regions that produce the largest quantities of this fruit are the sections that drain into the Connecticut river, Windham, Windsor and Orange counties, and Addison and Chittenden on Lake Champlain. The number of bearing apple trees is 1,183,529. The total number of fruit trees is 1,266,700. This leaves for peaches, pears, plums, cherries and all orchard fruit trees other than apples, 82,171. The total number of nut trees, such as black walnuts, butternuts, hickory nuts and chestnuts, is estimated at 24,534. The total area of small fruits estimated in acres is 469, of which 267 acres are in strawberries.

Granville Lowther

SHOWING THE EXTENT OF COMMERCIAL ORCHARDING IN VERMONT AND THE LOCATION WHENCE SHIPMENTS ORIGINATE.



Vetch, Hairy. See *Apple Orchard, Cover Crops.*

Vinegar. See *Index*, also pp. 669, 810.

Virginia

From the sea level on the eastern side of Virginia to the mountain tops on the west there is a difference in altitude of 7,000 feet. The coastal plain is level and rises to a height of 400 feet, where it joins the Piedmont plateau, which is undulating, in some places hilly, and rises to a height of 1,300 feet. This section joins the Blue Ridge mountain region, which separates the Piedmont from the Valley of Virginia, famous for its beauty, fertility and fruits. This valley is about 20 miles in width, is undulating, with frequent low ridges and spurs of the mountains. West of the Valley of Virginia and separating it largely from West Virginia is the Alleghany mountain system, with several small valleys, the soils of which are fertile and well adapted to the growing of all farm crops. These valleys are rich in limestone, and the soils furnish both mineral and vegetable elements necessary to the growing of high-grade fruits. The Piedmont sec-

tion is similar in character. Prominent in this section there is also a red clay, called by some "the Porter loam," which adds to the quality of the soils. There are very few apples and pears grown in the coast section, this region being better adapted to the growing of small fruits and to trucking. The apples are grown mostly in the Piedmont and valley sections.

Virginia has come to be famous for the fine quality of her Winesap and Yellow Newtown apples. The Yellow Newtown in that section bears the name of Albemarle Pippin, after Albemarle county, where it grew to such perfection that it became famous in both Europe and America. The climate on both sides of the mountain range is well adapted to the apple as is evidenced by the fine, vigorous trees, some of them more than 100 years old. Under especially favored conditions of soil and moisture, where the roots could penetrate deeply, where there was seepage from the higher lands furnishing plenty of moisture, and yet where there was good drainage, some of these trees have yielded fabulous crops and brought immense profits. One tree measures nine feet five inches in circumference; from side to side its branches measure 90 feet; 130 bushels of apples have been picked in one year. Our observation of old trees in general is that the fruit is of inferior grade, but where the life and vigor of the tree can be preserved this is not necessarily true.

In this section the inhabitants point with pride to the fact that here Thomas Jefferson took an active interest in horticulture, and from the "vicinity of Monticello apples won their first supremacy in the markets of the world."

The Blue Ridge and Appalachian sections up to an altitude of 4,000 feet may grow good fruit in specially favored sections, in coves where the soil is rich in humus and where there is seepage to furnish sufficient moisture, but these lands are largely undeveloped.

Of the fruits of Virginia apples contribute about nine-tenths, while all other fruits, such as peaches, pears, grapes, cherries, apricots, plums, etc., contribute

Rose Cliff Orchard, Waynesboro, Va.

one-tenth. Grapes are of fine quality, but are not grown largely for commercial purposes. Near Charlottesville, however, a winery has been erected and the quality of its products is said to be equal to the best of the same kinds manufactured in France.

The counties producing the largest quantities of apples are Albemarle, in the Piedmont section, and Augusta, adjoining it on the west on the opposite slope of the mountain range in the Valley of Virginia.

Among the advantages claimed for Virginia as a fruit-producing section are its relation to good markets and its shipping facilities.

Situated as it is on the Atlantic coast, with railroads extending in all directions into the interior, it has rather unusual transportation facilities, except in the mountainous regions, where farming is not extensively conducted.

The census of 1909 showed a smaller number of bearing apple trees in Virginia than the census of 1900, but the value of the crop was more in 1909 than in 1900. This is due largely to the fact that the old trees are dying and the commercial orcharding is passing into the hands of large producers, who grow better grades of fruit than formerly. Pears are grown successfully in almost all the fruit sections of the state, but are not grown extensively.

Cherries grow to a high state of perfection. The sweet cherries can be very successfully grown for commercial purposes, the trees growing to immense size and yielding profitable crops. However, like many other crops that could be grown successfully, they are not grown extensively.

Among the nuts that can be grown successfully are the English walnut, black walnut, chestnut and pecan.

Small fruits, such as strawberries, blackberries, raspberries, dewberries, currants and gooseberries, flourish in all parts of the state. GRANVILLE LOWTHER

Production of Fruits in Virginia

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	. . . . .	7,295	8,796	11,342,980	$671,843
Strawberries	4,651	6,606	7,821	10,761,381	626,649
Blackberries and dewberries	1,586	344	444	273,551	16,485
Raspberries and loganberries	1,121	276	365	257,322	24,853
Currants	205	5	39	8,127	791
Gooseberries	239	22	66	23,447	1,909
Cranberries	2	40	. . . .	18,112	1,050
Other berries	2	2	61	1,040	106

Strawberries are by far the most important of the small fruits raised in Virginia, with blackberries and dewberries ranking second in quantity and third in value, while raspberries and loganberries are third in quantity, but second in value. The total acreage of small fruits in 1909 was 7,295 and in 1899, 8,796, a decrease of 17.1 per cent. The production in 1909 was 11,343,000 quarts, as compared with 13,474,000 quarts in 1899, and the value was $672,000 in 1909, as compared with $765,000 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quan-

tity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total		9,609,799		4,631,587	6,581,101	$3,582,359	10,497,401
Apples	115,881	7,004,548	61,499	3,435,591	6,103,941	3,129,832	9,835,982
Peaches and nectarines	63,172	1,585,505	29,415	780,551	243,446	227,141	357,339
Pears	55,122	457,177	29,354	255,083	74,486	63,424	88,400
Plums and prunes	28,324	171,667	12,582	59,127	22,597	22,772	21,167
Cherries	47,492	352,783	14,003	83,323	132,671	134,428	188,693
Apricots	1,629	3,853	814	3,233	515	723	678
Quinces	9,547	34,256	3,562	14,679	3,443	4,037	(2)
Mulberries	4	10			2	2	(2)
Unclassified							[3] 5,142
Grapes	27,078	424,701	7,163	136,026	4,108,694	156,266	3,608,903
Nuts, total		[4] 53,184		[4] 13,964	[4] 841,572	[4] 22,161	376,440
Persian or English walnuts	371	3,540	194	1,642	22,512	1,231	1,450
Pecans	209	868	240	2,337	10,568	1,356	1,340
Black walnuts	2,586	23,049	670	9,173	600,141	9,723	(2)
Chestnuts	459	25,228	19	531	201,364	9,686	(2)
Unclassified							[3] 373,650
Tropical Fruits, total		[5] 10,264		[5] 4,963		[5] 9,705	
Figs	1,489	10,136	508	4,925	234,057	9,652	7,840

[1] Expressed in bushels for orchard fruits, and pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes Japanese chestnuts, Spanish chestnuts, hazelnuts, Japanese walnuts, almonds, butternuts, hickory nuts, filberts and other nuts.
[5] Includes oranges, lemons, pomeloes (grapefruit) and Japanese persimmons.

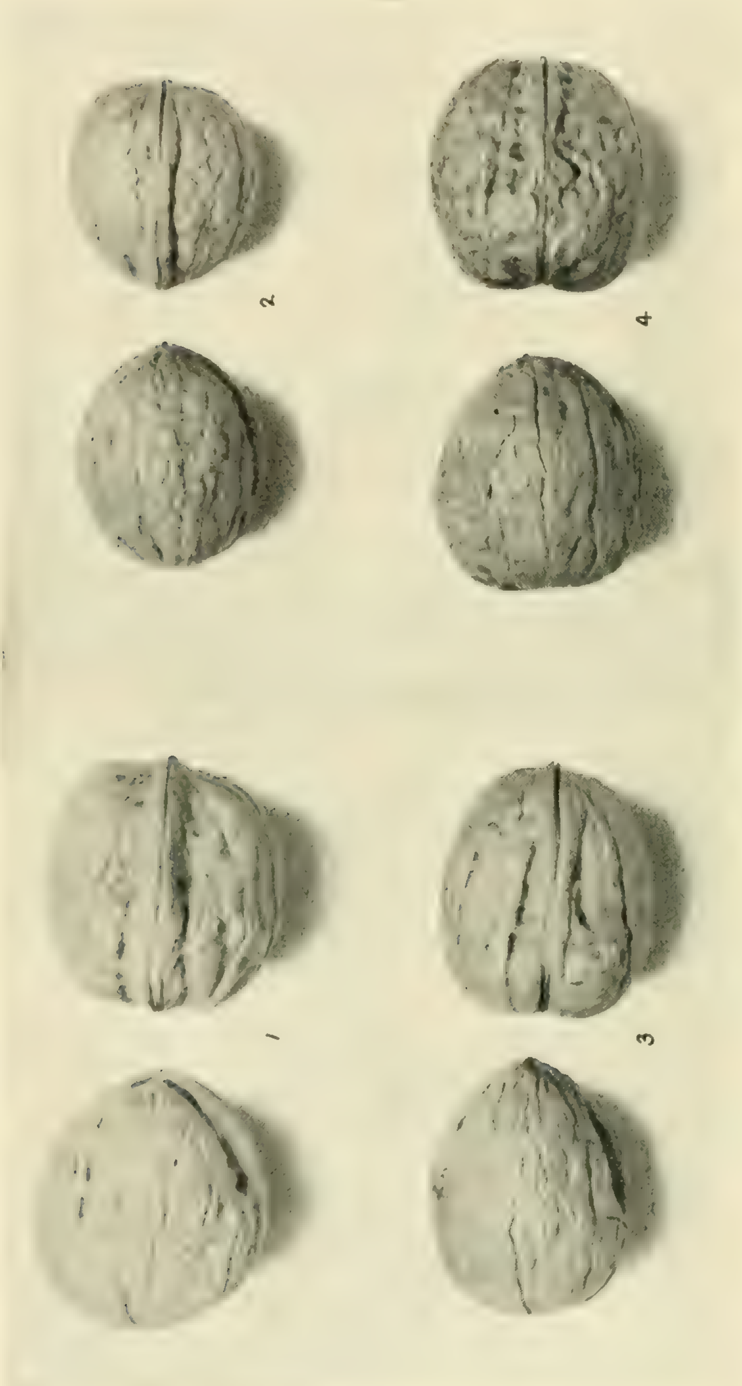
The total quantity of orchard fruits produced in 1909 was 6,581,000 bushels, valued at $3,582,000. Apples contributed more than nine-tenths of this quantity, peaches and nectarines and cherries most of the remainder. The production of grapes in 1909 amounted to 4,109,000 pounds, valued at $156,000, and that of nuts to 842,000 pounds, valued at $22,000. The tropical fruits in 1909 were valued at $9,705.

The production of all orchard fruits together in 1909 was 37.3 per cent less in quantity than that in 1899, while the production of grapes increased materially. The value of orchard fruits increased from $2,662,000 in 1899 to $3,582,000 in 1909, and that of grapes from $88,000 in 1899 to $156,000 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	6,377	3 5	Gals	469,651	1,385,843
Vinegar	7,669	4.2	Gals	268,457	517,041
Wine and grape juice	4,767	2 6	Gals	49,609	41,336
Dried fruits	8,918	4.8	Lbs	929,546	2,302,480

Wages of Farm Labor. See under *Farms*.



Washington Walnuts.

1. Spanish Mission, or Los Angeles Type; 2, Chaberte; 3, Mayette; 4, Parisienne.

—*Grown by Mr. A. A. Quarnberg.*

Walnut

The walnut is the edible nut of any tree of the genus *Juglans*, especially *Juglans regia* and *Juglans nigra*. Generally in the United States *Juglans regia* is called the English walnut, although it is sometimes called the French walnut, European walnut or Madeira nut. It was cultivated in Palestine in the time of Solomon, and was later known among the Romans as Persian nut, Royal nut, Eubean nut and Jove's nut. It is round-oval, rather ellipsoidal in shape; is from one to two inches long and has a thin husk which shrivels away irregularly from the light colored rather smooth, thin shell. This shell incloses a kernel, which is highly prized for eating and yields an excellent oil. There is no place known to the writer where the English walnut is so extensively and profitably grown as in California. The tree grows well in Oregon and in some parts of Washington, but is not so extensively grown in these states as farther south.

If walnuts are to be grown successfully for commercial purposes in the states of Oregon and Washington, it would seem to be necessary to plant the hardier varieties, such as the Proeparturien, Mayette, Chaberte, Parisienne, and especially the Franquette. These varieties are said to be hardier than most others, and are often grafted on the black walnut stock.

When dormant the walnut is hardy and will stand considerable freezing, but when growing it is tender. Therefore no place subject to early warm weather and late spring frosts can grow walnuts successfully. It is also sensitive to extremely hot, dry weather, which scorches the nuts and leaves, therefore it cannot be grown in the extremely hot and arid regions, but succeeds in Southern California, if grown along the coast, where the breezes from the ocean temper the heat.

*The English walnut is found growing very extensively through Western and Southern Oregon; specimen trees and small plantings are found from Portland to Ashland. In nearly every city of Western Oregon one will find bearing trees; more especially is this true in the Willamette valley. These plantings vary from a few trees to 20 or 30 acres of young orchards, and even much greater acreage is found. These are also found growing over parts of Eastern Oregon as far as Baker City. Probably the large commercial area of walnuts in this state will eventually be found west of the Cascade mountains.

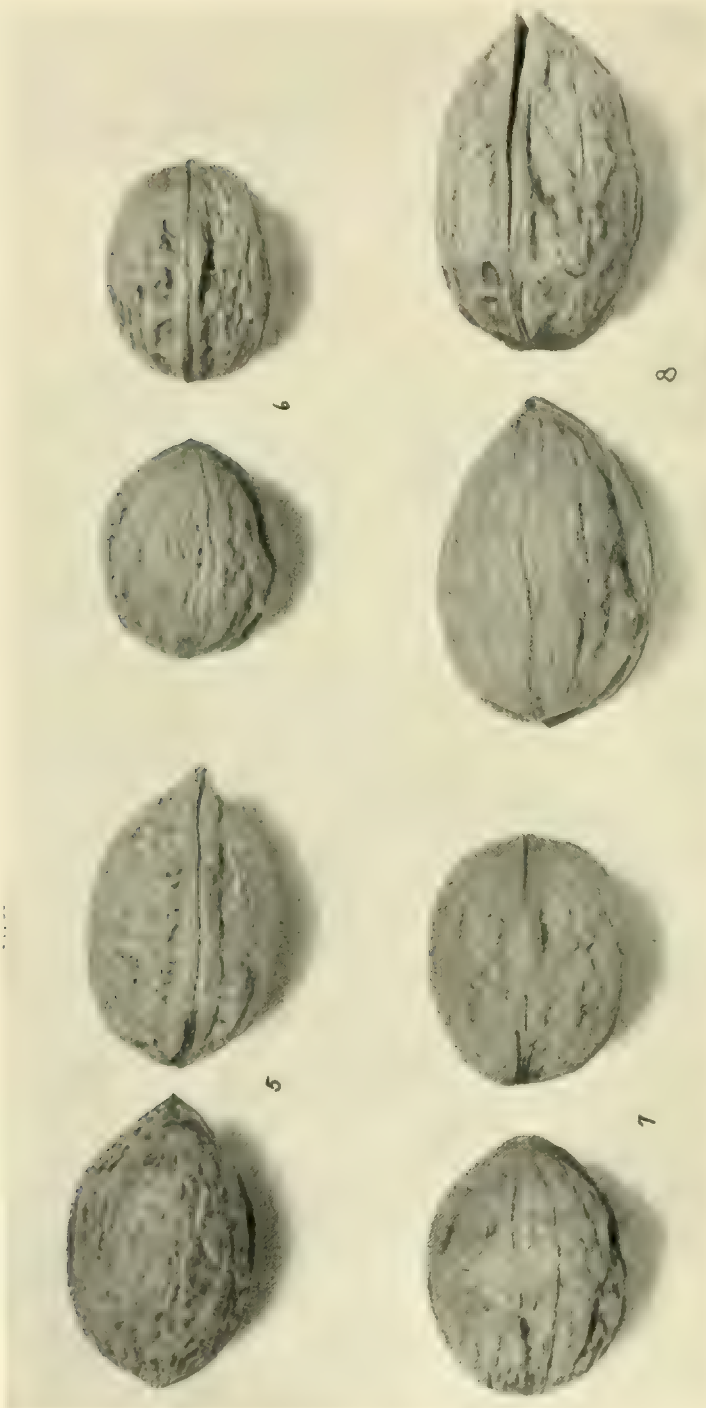
The root system is such that it requires a well-drained alluvial soil. The trees are heavy feeders and the soil must be rich and porous. Heavy clay lands are not adapted to walnuts.

In the nursery the nuts are planted in rows about like corn rows and the nuts about one foot apart. They are then cultivated to keep down the weeds, and if the soil is sufficiently deep and loose the tap root will penetrate to a depth of six to eight feet, while the top will make a growth of only two feet. Then, in the winter or spring, they are grafted and treated in much the same manner as apple trees. After removing from the nursery and planting in the orchard, the growth is slow for the first year, but by the end of that time the root system has a good start and the top grows rapidly.

No one has so improved the walnut as Luther Burbank, whose work has been

American Black Walnut.
Grown in Washington.

* Oregon Experiment Station Bulletin 111.



Washington Walnuts.
5, Kaghazi, or Persian Walnut; 6, Proeparturien; 7, Second Generation Cluster; 8, Franquette.
—*Grown by Mr. A. A. Quarnberg.*

worth millions of dollars to the walnut growers of California.

Black Walnut

The black walnut grows a nut that is rich, oily and much prized by some persons, but the shell is thick and hard, and the nut does not sell in the market as well as the English walnut. It has a much higher northern range than the English walnut.

Butternut

The butternut, *Juglans cinerea*, sometimes called the white walnut, has an oily nut, with a hard, elongated tubercled shell. It is not grown largely for commercial purposes.

Butternut Grown in Yakima Valley, Wash.

English Walnuts in Washington

Walnuts can doubtless be grown in favored localities in Eastern Washington.

Mr. W. P. Shepard, of Chelan, Washington, says: "I became acquainted with the walnut industry here 10 years ago with a small orchard of about 100 trees of walnuts from grocery stock, planted about 10 years before as an experiment. These being seedlings, varied widely in fruit and character, but came into bearing at the ages of five, six and seven years from the seed, and have borne regular crops every year since that time. Some of the trees are now 30 feet in spread and most of the walnuts are of excellent quality, identical with some of the most tender varieties grown in America. Doubtless the influence of the deep water of the lake, which never freezes, accounts for the fact that the walnuts can be grown in this latitude There are now several young bearing orchards about the lake."

A letter from Mr. Heartgood, also of Chelan, says: "I have 150 trees 14 years old and they have been bearing every year since they came into the bearing period."

Mr. A. A. Quarnberg, horticulturist and nut specialist, Vancouver, Washington, says: "Generally speaking, I do not consider walnut-growing a success east of the Cascade mountains. That is not saying that walnuts cannot grow there, as there may be limited areas fairly situated where they would succeed. Neither do walnuts succeed everywhere west of the Cascades.

"The location for walnut groves must be carefully selected or failure, partial or complete, will be the result. In the Yakima valley I would try the hardier varieties, such as the Rush, Pomeroy, etc., rather than the delicate varieties that are grown west of the range. As horticultural inspector I spent more or less of four years' time in the Klickitat country. On the lower elevations with good soil and exposure I found some good-looking walnut trees; in the western portion of the country and one place in the eastern part, which was protected from the cold and winds, I found a few very fine-looking walnut trees, while in the exposed sections of the same neighborhood they were not successful.

"It is claimed that the first English walnut tree in the state of Washington grew in Vancouver. Mr. Gay Hayden, in 1853 or 1854, secured some nuts from a ship anchored in the harbor and planted them in his yard in Vancouver. There are now between five and six hundred acres of English walnuts planted in Clarke county, Washington.

"The walnut requires a deep soil with plenty of moisture. In its native state it generally grows in a rich alluvial soil and succeeds best where the conditions

Glady.

—*Grown by Mr. A. A. Quarnberg, Vancouver, Wash.*

are favorable for an extensive root system."

English Walnuts in Southwestern Washington

The planting of nut-bearing trees has gradually attained such proportions in this section that nut-raising undoubtedly will in the near future become one of its important industries. Foremost among a variety of nut trees planted is the walnut, known in America under the name of English walnut, given it by the colonists to distinguish it from the native or black walnut.

In Clarke county about fifty-five years ago was planted the first English walnut tree in all the Northwest which, without any particular care, had grown to such proportions that when cut down in 1907 to clear the way for the North Bank railroad, its trunk measured seven and a quarter feet in circumference and the spread of the crown was over fifty feet in diameter.

There are two strains of English walnuts grown on the Pacific coast—the Southern California or Spanish Mission, and Chili varieties, and the European or French varieties. The first-mentioned strain of walnut trees is tender, buds out too early in the spring, is irregular in blooming and does not succeed well in the Northwest.

From the sole planting of that unproductive kind of walnut trees people for a long time were under the impression that this part of the country was not adapted to walnut culture, as trees even 40 to 50 years old remained comparatively barren.

With the introduction of the hardier and late-blooming French varieties that opinion has changed, and walnut-growing is now considered one of the most promising of future industries. The climate and soil are said to be very similar to those portions of France which for generations have been producing the world's best walnuts.

The first French walnut trees, six in number, were planted in Clarke county in the spring of 1888 by William Smiley in Fruit valley; they were bought from that veteran French walnut propagator, Felix Gillet, of Nevada City, California, and among them were two grafted trees, one Mayette and one Franquette, which for the past 12 years have borne continuous crops of fine nuts, showing that just as good nuts may be grown here as in France, where walnut culture has been an industry of such vast proportions.

The next lot of French walnut trees brought to Clarke county consisted of nine trees, also bought from Felix Gillet, in the winter of 1893 and 1894, by the writer, and planted in Fruit valley. In the spring of 1894 Augustus High set out the first trees of that now fine French walnut orchard in Fruit valley, and the same year Henry J. Biddle planted the first walnut trees on his place six miles east of Vancouver.

These experimental French walnut trees flourished surprisingly and were the cause of later plantings, which have been increasing annually. The writer's 15-year-old trees now measure three and a quarter feet around the trunk near the ground and their height and spread of crown are each about 30 feet.

The old French standard varieties such as Mayette, Franquette, Chaberte, Parisienne, Proeparturien, etc., are mostly planted. Second-generation trees are those grown from nuts borne on the first-generation trees or the original variety reproduced solely by grafting.

While the orchard is young, hoed crops can be raised between the trees or other fruit trees may be planted as fillers and removed when crowding begins.

So far the English walnut trees have been remarkably free from disease and insect pests in Southwestern Washington, and with good care and cultivation they generally have come in bearing when seven or eight years old, and their bearing capacity naturally increases with the age and size of the trees. However, "walnut blight" has now made its appearance in the Northwest, and that will necessi-

tate the selection of blight-resistant varieties for planting hereafter.

The best-bearing English walnut trees in France are between 100 and 200 years old, and some trees are of astonishing old age and great size and yet immensely productive.

There are but few more handsome ornamental trees than thrifty English walnut trees, and, planted either for the house, the yard or lawn, they add much to the beauty and value of a home.

Propagation of Walnuts

A Method of Budding the Walnut

Many difficulties have confronted the nurserymen and the orchardists alike in the propagation of the best varieties of English walnuts. Various methods of nursery grafting and budding have been employed with varying success. In general the percentage of unions has been very small, resulting in a consequent high-priced tree. The method of budding as outlined in the following paragraphs consists in the combination of the old principles adapted to new subjects and conditions. By this method, and the exercise of ordinary care, with good buds, and one-year-old seedlings, at least 70 to 90 per cent of the buds should take and form satisfactory trees.

Stocks

Various stocks have been employed, and among these may be mentioned the English, the American Black and the hybrid between the California Black and the English. The best of these is the California Black, and the least desirable the English. The hybrid is very frequently used, but in some cases is not dependable, such stocks being very variable, some giving a good root system and others poor.

Buds Used

Up to the present time usually buds of the current year's growth have been employed in attempting to bud the walnut. This is unsatisfactory from several standpoints. In the first place the bark on the current year's wood is exceedingly tender, and the outer layers are very apt to be rubbed off in handling. Second, the leaf stem is attached below the bud, and if this is removed before the bud is inserted a large scar is left, which is a source of oxidation and loss of moisture, both of which tend to prevent a satisfactory union. If this stalk is left on the bud it is very difficult to tie properly. This difficulty has been avoided somewhat in the past by cutting off the leaf several days before the buds were taken for budding, and the remaining leaf stalk soon shrivels and falls away.

Japanese Walnut Grown Near North Yakima, Washington.

In the method as outlined in this article buds one year old are used. These will be found at the base of the current year's growth. Only those plump buds which have remained dormant are to be employed, although if material is scarce smaller buds may be used, but they do no break with the same ease that the larger buds do.

It is also possible to use buds from scion wood cut during the winter, or very early spring, when it is in a perfectly dormant condition. If such scions are placed in moist sand for a couple of weeks before the budding is done the buds may be removed quite easily. Although the labor is somewhat increased in removing the buds from the stick, yet there are more large, plump buds available than if taken later in the season, when many of the desirable buds have broken into shoots.

Making the Bud

(1) The Hinge Bud: About one inch above the surface of the soil make a transverse incision about half an inch long, and a similar one about three-fourths of an inch above this. Connect the two with a longitudinal incision. This forms the completed "I" cut on the stock. It is very desirable to use extra care in making these cuts. The ideal condition is to merely penetrate the bark just to the wood but not cut into it. The bud, which is rectangular and of exactly the same length as the distance between the two transverse cuts on the stock, is removed from the bud stick by first making two transverse cuts of the proper distance apart to give the correct length to the bud, and then connecting these by two longitudinal cuts about half an inch apart. The bud proper should be approximately in the center of this piece. The bud is then easily removed by gently inserting the back of the knife blade under one corner of the piece of bark, and prying up, when it will be found that it will readily part from the bud stick. No wood should be removed with the bud, and care should be taken when the bud proper is extra large to avoid pulling the soft wood or core out of it. It may be necessary in such a case to first loosen the bark containing the bud on one side up to the bud proper, then carefully cut this soft core with a knife, and the remainder of the bud piece may be easily removed. As soon as the bud is removed from the bud stick it should be immediately inserted into the stock. This is readily accomplished by first carefully turning back the upper corners of the "I" shaped cut, slightly prying them away from the wood, then inserting the base of the bud into the opening, pushing it down until the top and bottom of the bud are flush with the transverse cuts on the stock, and the bud lies smoothly and snugly against the latter. By making the bud force its own passage under the bark of the stock after this manner there is much less exposure to the air than if the sides of the cut are first turned back and the bud then laid in place. The bud is now ready for tying and waxing as explained below.

(2) The Flute Bud: In this method of budding it is best to first shape the bud and then cut the stock to fit it. The bud, which is rectangular, about three-fourths of an inch long, and five-eighths of an inch wide, is made and removed from the bud stick exactly as in the preceding. A similar piece of bark is removed from the stock and the scion bud is then put in its place, taking care to see that the sides of the bud fit up snugly all around.

The T and inverted T buds proved unsatisfactory in our work.

In either case after the bud is well in place on the stock the two are wrapped snugly with raffia. Special care should be exercised in the wrapping to see that the bud is pressed firmly against the wood of the stock, especially at the center where the bud proper is located. Much of the success of the operation depends on proper wrapping. In many cases there is a prominent elevation where the leaf stalk has become detached, and unless care is used in pressing this down firmly in the tying it will draw away and no union will result. When properly tied wrap the entire bud with waxed cloth to keep out moisture and air, and wax all over with some good wax. The following is recommended:

Grafting Wax

Resin, five pounds; finely pulverized wood charcoal, one-half pound; beeswax, one pound; raw linseed oil, one gill.

First melt the beeswax and resin, add the charcoal, stirring constantly, and then add the oil. Mould into cakes by pouring into greased pans. When desiring to use break off a few lumps, melt and apply in a liquid state with a brush or swab.

A more rapid method of making the bud air tight is the following: After tying with raffia tear a small piece of soft paper, newspaper is good, about one and a half by two inches, then holding this in place over the bud thoroughly wax over the whole and in addition about one-half to three-fourths of the way around the stock. The paper prevents the wax from getting into the bud, but even should this happen it would cause

English Walnut Tree on the Snake River in Whitman County, Washington.

little trouble, as the buds in starting will break through a light covering of wax. During warm weather it is a good plan after waxing to tie a piece of paper or paper sack split down the side over the bud to protect it from the sun. If the trees stand closely in the rows, and have sufficient foliage to shade the trunks, this will not be necessary. In about ten days after waxing the bud will have sufficiently united with the stock so that the wax and paper may be removed, and about a week later the raffia should be cut and removed. Care should be exercised, however, in the last regard in that if the stock is growing very rapidly the raffia is apt to girdle it. In such a case the raffia should be cut sooner, or if the bud is not sufficiently united, retie more loosely.

Starting the Bud Into Growth

If the budding has been done in June or earlier and the buds are to be started into growth the same year, the trees should be headed off at the time the raffia is removed—about 15 days after the budding. Cut off the stock about one and a half to two inches above the bud, allowing the top to remain attached at one side by a small piece of wood or bark. These tops should then be broken over and laid overlapping each other in the row, thus providing shade to the buds and aiding in the carrying off of excess sap and preventing to a considerable extent an excessive sprouting from the root. In about two weeks the scion bud will have started into active growth. The top of the stock should then be removed entirely, close to the bud. In sections subject to high winds, the young shoots should be staked. See that all buds and shoots from the stock are taken off, as they are a material drain on the reserve food supply in the stock.

If the budding has been done late in the season so that the trees can not be headed back before August 1, such heading back had best be deferred until the following spring, just about the time that growth starts. There is some danger of the buds being killed during the winter, or injured by excessive wet weather. It is therefore preferable in such cases to put the buds somewhat higher on the stock than when the trees are to be headed back in June or July. Trees coming from stock headed back about the middle of June to the first week in July will make from 14 to 20 inches growth the same season, and usually mature thoroughly, so that there is no danger of killing back during the winter. Such young trees could be put on the market the winter following the budding. Trees from stock which has been headed back in the spring will make a straight growth of five to seven feet during the season.

E. J. Kraus,
Oregon Experiment Station.

WALNUT DISEASES

Black Sap. See *Sun Burn*, this section.

Walnut Blight or Bacteriosis

Pseudomonas juglandis

This disease is the most important one affecting the English walnut as grown in the United States. It has been known in California for over 20 years, being first mentioned in scientific literature in 1893* Since then the disease has spread until at present it is well distributed through the walnut-growing sections of California, and also is to be found at other points on the Pacific coast. In foreign countries the disease has been reported from New Zealand, and California walnut growers who have visited France report having seen the disease there. These observations have been confirmed by those of Professor R. E. Smith, who, during a recent visit to France, saw there typical cases of walnut blight on nuts, twigs and nursery stock. The disease was undoubtedly brought to California on nursery stock and scions imported from France. **

Hosts

The natural occurrence of the disease is probably confined to the English walnut and its hybrids with the black walnut. Blighted nuts have been found on a Paradox walnut tree (a hybrid of English and California black) and in one instance

* Report of Secretary of Agriculture, Division of Vegetable Pathology, 1893, p. 273.

** California Cultivator, Vol. 61, No. 12, September 18, 1913.

Walnut Blight.
Fig. 1. Walnut Bacteriosis on Twigs, Showing Lesion on Older Wood Healing Over.

blight infection spread in the nursery and infected the leaves of a California black walnut seedling. Several different species of juglans have been artificially infected from pure cultures of the organism.

Characteristics of Disease

The disease may be found on any of the tender new growing parts of the tree, such as young nuts, branches, nursery stock, and the vascular system and parenchyma of the leaves. The affected parts have a characteristic blackish color, and often pronounced lesions are produced. The disease never kills back the branches to any great extent, neither does it cause defoliation of the tree, and were it not for its occurrence on the nuts, would be of little economic importance, except sometimes on nursery stock, where the disease is especially severe in the succulent growth of the graft.

The disease is especially virulent and destructive on the young nuts. Many of these become diseased and fall when from one-eighth to one-half an inch in diameter. These infections on the small nuts may take place at any point, but are more frequent at the blossom end, and readily spread to the kernel or meat of the nut, which becomes black and unfit for use. The most destructive period of infection is early in the season, during April and May in Southern California. Later during the summer, under favorable conditions, a superficial infection may occur, which shows as small, dark-colored areas scattered over the surface of the nut. This infection is usually of little importance, as the climatic conditions are unfavorable and the outer tissue of the nut has commenced to harden, and so is unfavorable for the deep development of the disease.

The infection first appears as a small discolored or water-soaked area. This gradually increases in size and becomes blackish in color, with a surrounding water-soaked zone of affected tissue. The diseased tissue at length becomes black and may have a shrunken, dried out and cracked appearance. The diseased condition in the branches does not continue to increase after the first year and eventually dies out, when the injury again heals.

Cause

The disease has been proven to be produced by a species of bacteria (*Pseudomonas juglandis*) living in the diseased tissue. Professor Newton B. Pierce first

isolated the organism, which has since been isolated many times and its cultural characteristics described. Pure cultures of the organism, when atomized on healthy walnut tissue, will cause typical walnut blight. The organism produces a yellow growth on media, has a single polar flagellum. Its winter habitat is in the diseased branches of the previous year's growth. It probably does not live over in the fallen nuts and leaves.

Loss

The loss from the disease varies from year to year. In one of the first bad blight years, that of 1903, the crop in California was only about one-half that of the previous year. It is probably conservative to estimate the average loss of nuts during the past ten years from blight in the seedling groves of Southern California as from 30 to 50 per cent. During the last decade the walnut acreage has multiplied many times, yet the total crop has increased but little during this period.

Favorable Conditions

The amount of walnut blight infection corresponds closely to the amount of moisture, such as fogs, dews and other humid conditions. Rains rarely occur in California after the appearance of the small nuts, but foggy weather is more or less frequent. Low fogs and especially foggy nights are very favorable for blight dissemination and infection. At first only a few infections on young leaves or nuts are evident. From these there are other infections that may involve a large number of nuts.

Walnut Blight.
Fig. 2. Walnut Bacteriosis on Small and Half-Grown Nuts.

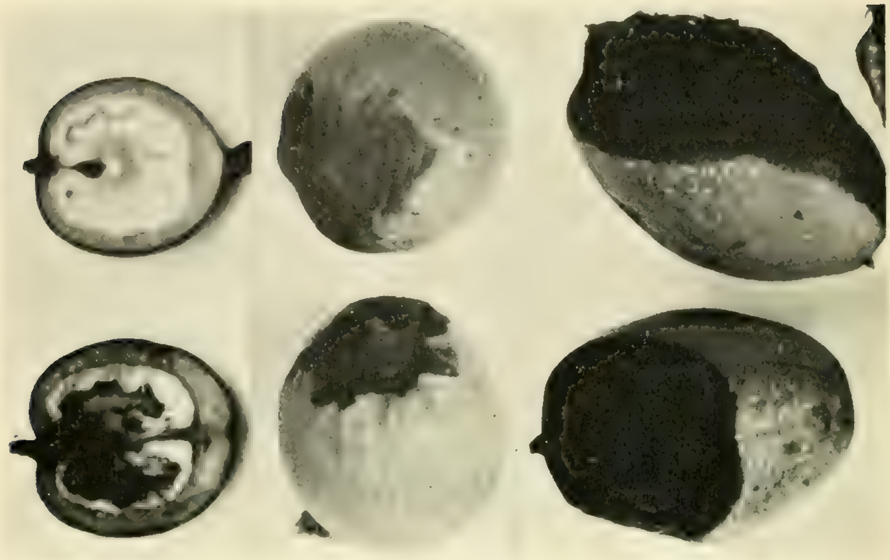


Fig. 3. Bacteriosis on Large Nuts, Stigma or Blossom End Infection. Section of two nuts, the one below affected with bacteriosis; above, normal nut.

It is not probable that insects play much part in the dissemination of the disease, although the organism has been isolated from flies which were found around walnut trees affected with blight. A species of aphis is often abundant on the leaves (rarely found on the nuts and branches) that probably causes some leaf infection, as well as a sooty deposit on nuts and leaves.

Natural Resistance

Considerable variation exists between individual varieties as to susceptibility to blight. The walnut groves of the past, and largely of the present, are seedlings. Individual trees often show considerable resistance to blight. This immunity in a large measure is due to a later blooming period. The difference in time of blooming is frequently one to three months between the earliest and the latest French varieties. Such a wide range in time of blooming gives considerable chance for difference in climatic conditions. Some of these late varieties are comparatively free from blight, although no variety is thought to be immune to the disease, and even some of the most resistant and for this and other reasons most desirable kinds will show, during certain seasons and in certain localities, some blighted nuts. The number, however, is so small as to be of little commercial importance. A variety should not be propagated alone for blight resistance, unless the other characteristics of a good nut are present. It is more profitable to grow a productive tree that gives some blighted nuts than a scant producer that never blights. It has become the practice among the best walnut growers of California to graft over their worst blighting and poorest yielding trees to better varieties. Doing this a little every year does not diminish the yearly output to any marked extent, and in a few years the crop will be increased. Freedom from blight is not of necessity resistance, but may be due to the fact that the disease is not yet present or the conditions are unfavorable for blight development. Care should be exercised in concluding too hastily that a given variety is resistant before it has been tested in sections and groves that show this disease. The most promising means of control will be secured by growing more resistant and better varieties of walnut.

Walnut Spraying

Experiments in spraying walnuts have been carried on by the United States Department of Agriculture, by the University of California,* and by a number of walnut growers. Bordeaux mixture 5-5-50 and lime-sulphur, as well as other sprays, have been used. The conclusions from the work thus far done are as follows: (1) There are undoubtedly some beneficial effects on the tree from Bordeaux and lime-sulphur sprays, especially in the control of the aphis by the latter spray, and of various fungi. (2) The cost in materials and time is rather large, being from 30 cents to $1 per tree, according to size, thoroughness of application, and equipment. (3) The thorough application to large trees is slow even with the most improved machinery. (4) It has not yet been demonstrated that spraying for the control of walnut blight is very effective, although there might be a cumulative effect from a yearly application through a long period of time.

C. O. Smith,
University of California.

* Walnut Culture in California, Walnut Blight, California Experiment Station Bulletin 231.

Circular 107, California Experiment Station.

Crop Failure

It is a very noticeable fact in connection with the California walnut industry that the total product of the groves of the state is not materially increasing, although the acreage has multiplied many times during recent years. This is due to a very general condition of poor production in the large walnut-growing sections of the southern portion of the state.

Trouble of this nature is quite commonly attributed to walnut blight, with which disease, however, it has nothing to do. There is probably no one cause or reason for this condition. It is due, generally speaking, to a loss of vitality in the trees, brought about mostly by unavoidable mistakes made in planting when the industry was new and experience in walnut growing very limited. These mistakes are, briefly:

1. Too close planting. The common practice of setting 40 feet apart is not

Walnut Blight in Foliage.
Fig. 4. Leaves Affected with Bacteriosis, Showing Diseased Vascular System, and Small Black Diseased Spots on Leaf.

adequate when trees reach ten years or older.

2. Lack of cultivation and fertilization.

3. Unfavorable soil for the walnut root. This root requires a very deep, porous soil.

4. Deterioration of stock through improper seed selection.

5. Climatic conditions.

These faults suggest their own correction.

R. E. Smith,
California Experiment Station Bulletin 218.

Crown Gall—Black Knot. See *Apple Diseases*.

Die Back

The limbs die back from the ends, sometimes for only a short distance and sometimes down to the main forks of the tree. All the limbs or only a part of them may be affected. Two general types of die back may be distinguished, one on the old trees, particularly "hard shells," which die back slowly all over the top, and another in young trees from two to ten years old, which die back suddenly during a single winter in part or all of the limbs, or sometimes the whole tree dies back clear to the ground.

The former type of die back, affecting old trees, occurs mostly on light soils, where the trees are getting old and the roots find insufficient moisture. Such dying back is also hastened by lack of cultivation, irrigation and plant food, which lack becomes more pronounced as the trees grow older and the tops and roots become more crowded. The only remedy for this trouble is to thin out the trees where they are too closely planted and give the soil better care. Most of these old hard-shell orchards, even at best, have now become so unprofitable and undesirable as to make it seem better for the owners to cut down the trees and use the land for some other purpose.

The second form of die back mentioned, that occurring in young trees which have formerly been thrifty, killing them down to the forks or even to the ground, is a very serious matter in some districts. The trouble shows usually to a greater extent in a certain portion of the orchard or in certain orchards worse than in others near by.

This disease is practically the same in its nature as that described as "Little Leaf" of the peach, and shows similar relations.

Trees affected in this way should be pruned back to good live wood, if not too far gone, and it is to be expected that a new top will soon be produced. By proper attention to irrigation late in the season, especially in dry years, it is not to be expected that the trouble will occur again save in soils most unsuitable for walnuts on account of coarse subsoil near the surface.

R. E. Smith,
California Experiment Station Bulletin 218.

Leaf Diseases

The walnut is attacked by a number of leaf diseases, such as anthracnose or leaf blight, leaf spot and mildew.

These are likely to yield to spray treatment if they should become serious.

Little Leaf. See "*Yellows*," this section.

Mouse Injury. See *Rodents*.

Oak Fungus. See *Root Rot*, this section.

Perforation

The shell fails to develop properly, being only partially formed, with numerous openings and thin places. This appears to be simply a lack of development due to climatic conditions, and occurs in seasons with a dry spring and a dry, hot summer. Seems worse on trees attacked by aphis.

Root Rot

Oak Fungus—Toadstool Disease

The English walnut root is quite susceptible to the so-called oak fungus or toadstool disease, which occasions the loss of many fruit trees of various kinds in California. This disease consists in a decay of the roots, in which the white mycelium of the fungus may be found between the affected bark and wood. Occasional clusters of toadstools appear at the base of affected trees. The disease usually, if not always, occurs in spots where oak trees formerly stood, and when once started spreads from tree to tree in quite a

regular concentric manner. Experience has amply demonstrated that our native black walnut roots are immune to this fungus and we have seen cases where English walnut, prune, almond and other roots have been picked out and killed, while northern California black walnuts interplanted with these trees remained entirely unaffected. It is altogether probable that all of our black walnut species and hybrids are highly resistant if not totally immune to this disease.

Fig 1 Walnut Killed by Root Rot. *Armillaria mellea.*

Seedling Root Rot—Wilt

Nursery seedlings of the Southern California black walnut occasionally wilt and die rather suddenly, and show, on examination, a black rot of the main root just below ground. This may appear either before or after grafting, and, ordinarily, at the worst, picks out only a tree or two here and there, even in a large nursery. We have known of only one case where serious loss was experienced from this source, and this on poorly drained land where the trees were injured by an excess of water. The trouble is caused by a soil fungus, and seems to be confined to the Southern California black.

Shriveled Meat

Much trouble is experienced with walnuts in certain seasons on account of the meat being shriveled and poorly developed. This affects some varieties and some individual trees more than others, and is often much worse the same year in certain localities than in others. The trouble is more apt to affect varieties which come out late in the spring than those which develop early. The cause of this poor development or shriveling of the meat has been ascribed to various influences, none of which have been positively proven to bring about this trouble. The influences suspected have been the same as those to which perforation or non-development of the shell have been laid, namely, poor pollination, lack of soil moisture, and the attacks of the walnut aphis. Which of these actually causes the trouble has not been positively determined.

While this trouble cannot be attacked specifically, it can doubtless be alleviated by sufficient irrigation, cultivation and aphis control.

California Experiment Station Bulletin 231.

Sun Burn

Serious damage is sometimes caused from this source, both on the fruit and the tree. In the latter case the trunk is usually affected, dead areas developing in the bark on the sunny side. This originates mostly in winter when the nights are cold and the days bright and sunny. Not usually serious on thrifty trees growing in good soil. Black walnut trunks with rough bark are not affected by sun burn, so that trees grafted high on such trunks are immune.

On the fruit the sun sometimes has a disastrous effect, causing a blackening and burning of the husk on one side during extremely hot weather in summer. The meat is also blackened, and the husk sticks to the shell so that separation is difficult and a black spot is left. Thrifty trees are less affected, particularly when supplied with an abundance of moisture at the root. Individual trees or varieties vary in susceptibility to this trouble, and this quality should be considered in planting in localities where trouble from sun burn is likely to occur. R. E. SMITH.

California Experiment Station Bulletin 218

TOADSTOOL DISEASE. See *Root Rot*, this section.

Trunk Rot

Schizophyllum commune

The trunk or main branches rot, with a production of small, white bracket toadstools on the surface of the affected wood. This fungus does not affect sound trunks, but follows deep wounds, bruises, heavy cutting, sunburn or other injuries. The wood of the English walnut is particularly susceptible to this form of decay.

All severe cuts or wounds should be carefully covered with grafting wax to allow healing over without decay. In top-grafting walnut trees this should be given special attention or serious decay may follow.

WILT. See *Seedling Root Rot*, this section.

Yellows

Spindling, yellow shoots develop which usually die back from the tip. All degrees of the trouble may occur from slightly unnatural yellowing and slenderness of the normal shoots to the production of masses of small, yellow shoots, with continual dying back. This disease appears to be the same which affects the peach (which see), and also to some extent the pecan, apple, and many other trees. It is probably due to a climatic or soil condition rather than to any parasite. Conditions which result in sour sap and similar troubles in the stone fruits seem to be related to this disease, and it is very likely due to a disturbance of the dormant or resting condition through which these trees normally pass during the winter. Also seems to be connected with lack of rain or irrigation late in the season.

R. E. SMITH,
California Experiment Station Bulletin 218.

WALNUT PESTS

BLISTER MITE. See *Erinose*, this section.

CALIFORNIA TUSSOCK MOTH. See *Apple Pests*.

Erinose

Blister-like swellings appear on the leaves, sometimes becoming very abundant. This trouble is caused by an insect so minute that it is not visible to the eye.

Not serious or requiring treatment.

FROSTED SCALE. See *Apricot Pests*.

GREEDY SCALE. See *Apple Pests*.

PEAR THRIPS. See *Pear Pests*.

RED SCALE. See *Grape Pests*.

RED SPIDER. See *Apple Pests*.

SAN JOSE SCALE. See *Apple Pests*.

WALNUT APHIS, EUROPEAN. See *Walnut Callipterus*, this section, also *Aphids*.

Walnut Callipterus

Chromaphis juglandicola Kalt.

H. F. WILSON

This is a little green plant louse about one-eighteenth inch long which feeds on the leaves of walnuts throughout the summer. The life history has never been worked out, but we believe that it is about the same as other species of this group. The winter is spent in the egg stage on the twigs about the buds. As the buds are turning green in the spring little greenish-yellow lice issue from the eggs and, crawling to the opening buds, feed on the expanding leaves. Towards late spring winged individuals appear and migrate to other trees, where they produce living young. During the summer and until late fall viviparous females are pro-

Fig. 1. Mouse Injury to Nut Tree.
H. A. Gossard

Fig. 2. Mouse Injury to Nut Tree.
—*H. R. Gossard.*

duced. Then more winged forms appear, which produce true males and females. The males have wings but the females are wingless. Copulation takes place and the overwinter eggs are deposited by the females about the buds on the young shoots.

Remedies

Spray with "Black Leaf-40" or kerosene emulsion 10 per cent.

Walnut Caterpillar

Datana integerrima Gr. & Rob.

The walnut caterpillar does much injury to the walnut, butternut, hickory and pecan trees in the Mississippi states by eating their leaves and in many cases completely defoliating the trees. When full grown, the caterpillar is about two and one-half inches long, dark, nearly black in color, and sparsely covered with long, silky, white hairs. The eggs are of dull white color, and are laid in masses of from 200 to 300 on the undersides of leaves. (Fig. 1.) The caterpillars feed in large numbers, clustered together. They first work on one leaf, then on a branch, completely cleaning them up as they go. The moth has a body measuring three-fourths of an inch long and wings when spread measuring one and five-eighths inches in the male to one and seven-eighths in the female. The fore wings are of light brown color crossed by four darker brown lines; the hind wings are of pale yellowish color, unmarked. The winter is passed in the chrysalid stage in the ground.

Remedies

While the caterpillars are still young and feeding upon the leaves, they may be destroyed by spraying with arsenate of lead at the rate of from two to three pounds to 50 gallons of water. After the caterpillars have come down the tree and clustered there to molt, the mass may be burned or crushed. Parasites such as the Tachina flies are efficient in killing great numbers of this insect. The eggs of the fly are laid upon the caterpillar and later hatch into maggots, which feed upon their host, causing its death. So effective are these parasites that it is rare for the wal-

Fig. 1. Egg Mass of Walnut Moth. About One-half Natural Size. (Original.)

Fig. 2. Adults of the Walnut Caterpillar. Female above, Male below. (Original.)

nut caterpillar to do serious damage in the same place two successive years.

E. M. Bentley,
Knoxville, Tenn.

Walnut Mealy Bug

Pseudococcus bakeri Essig

General Appearance

Slightly larger than the citrus and long-tailed species. Does not secrete as much cottony covering and has tails half as long as the body.

Life History

Eggs are deposited in loose masses similar to those of the citrus mealy bug. Does not multiply nearly as rapidly as the other species.

Food Plants

Walnut, apple, pear and lemon. Works under the bark and in crevices upon the tender cambium layer.

Control

Spray with carbolic acid emulsion under 200 pound pressure.

Walnut Moth

Ephestia elutella Hubn.

This insect is recorded as being cosmopolitan in distribution, but so far we have no account of its being established in this country, but it is likely to be imported from Asia. It is a serious pest in its native haunts.

Walnut Scale

Aspidiotus juglans-regiae Com.

H. F. Wilson

This insect is found in two or three localities of Oregon, but as it has never been a serious pest in other sections of the United States where walnuts are grown, we do not believe that spraying will be necessary for some time. The scale of the female is circular, flat, with the nipple slightly out of the center. The major part of the scale is pale grayish brown, with the nipple reddish brown, diameter of scale .13 inch. The scale of the male resembles that of the female in color, but is elongated and is narrower. Length of scale .05 inch.

Remedy

Lime-sulphur as used for San Jose scale may be used with success when trees are dormant.

Weevil. See *Pecan Pests.*

White Peach Scale. See *Peach Pests.*

Washington

Washington is divided into two distinct sections by the Cascade range of mountains, and these sections are as different in their general characteristics as if they belonged to different zones. On the west of the mountains the state is heavily timbered for the most part, with plenty of rainfall for the growing of crops, a climate charged with moisture during most of the year, and a glacial soil formation. East of this range the soil is a volcanic ash, or disintegrated basaltic rock, arid or semi-arid in the eastern part, covered with sage brush and bunch grass, and crops cannot be grown without irrigation, except along the streams and on the high elevations, as in the extreme eastern part of the state, where the rainfall is sufficient for the growing of wheat, certain kinds of fruits, potatoes and other crops. For greater convenience the state has sometimes been divided into four parts. The first, along the coast between Puget sound and the Pacific ocean, including the Olympic mountains. This is rough and

rocky, rising to an elevation of 8,000 feet, is heavily timbered and, for the most part, is as yet undeveloped and unimproved.

The second includes the Cascade range east of Puget sound and west of the arid and semi-arid belt. This section is mostly mountainous, including the foothills on either side of the mountain range, and rises to an elevation of 10,000 feet, including a few peaks like Mt. Rainier, which rises to an elevation of 14,400 feet, and Mt. Adams, 12,500 feet.

The third division includes the Columbia River valley, an arid plain, except in the extreme north, which is mostly covered with timber, where the rainfall is sufficient for the growing of crops without irrigation.

The fourth section, the Blue Mountain region, in the extreme eastern and southeastern part of the state, rises to an elevation of about 5,000 feet, with the highest points 7,000 feet above the sea.

In the western part of the state the temperature is modified by ocean currents and breezes, and the cold of winter and the heat of summer are so modified that there are not the extremes of either heat or cold experienced in like altitudes further inland. In the eastern portion, the atmosphere is pure and invigorating, seldom very cold in winter, and in the summer, during July and August, the days are hot and the nights cool.

In Washington large areas of land have been brought under irrigation and planted to fruits, which, because of their superior quality, bring high prices in the markets of the world. What California is to the citrus fruits, Oregon and Washington will doubtless be, in their later development, to the deciduous fruits.

Chelan

The orchard sections around Lake Chelan are protected by mountains. The only outlet for air and water drainage is eastward to the Columbia river. The soil is a mixture of volcanic ash and disintegrated granite. This granite gives the soil a grayish appearance and also makes it porous and less liable to puddle from irrigation than the soils composed mostly of volcanic ash. The granite contains a mixture of lime, well adapted to the growing of apples.

English walnuts have been grown successfully at the lower end of this lake.

Okanogan

The soil of this valley is decomposed granite mixed with the volcanic ash, making it peculiarly adapted to the growing of commercial apples. The climate is colder than in the Chelan and Wenatchee districts and the snows comparatively deep. Yet the fruit trees are never killed and the bloom seldom if ever injured by spring frosts. The quality of the fruit is unsurpassed. Peaches, pears, plums, apricots, cherries and other fruits are grown in limited quantities.

In 1912, 689,868 apple trees three years old and under were planted. The Methow valley claims equal distinction for the quality of its fruits. There is in these valleys a large undeveloped area where the finest of winter apples and the hardier fruits will be grown.

Puyallup

Puyallup valley is the most famous berry-growing district in the state of Washington and one of the most famous in the United States. It lies on the west side of the Cascade range, not far from Puget sound. The soil is largely a wash from the surrounding hills and mountains and is mixed with vegetable matter. One particular feature of the berry industry of this section is the Berry Growers' Association, which operates a co-operative cannery and marketing organization which has helped to make the industry very profitable and has brought the value of the farm land to from \$500 to \$1,000 per acre. Strawberries, blackberries and raspberries are the principal crops.

Spokane

The Spokane district is in the valley of the Spokane river. In many parts of this section fruits are grown without irrigation. In these sections the Wagener apple reaches its highest state of perfection. The basic soil is volcanic ash, together with a considerable mixture of humus. In other places, especially in the Spokane valley proper, the soil is a fine gravel,

which at first would be accounted insufficient for the growing of fruits, but which is being planted to the extent of thousands of acres.

Walla Walla

The Walla Walla valley is one of the oldest agricultural and horticultural districts in the state of Washington. It was soon proved by experience that fruits could be successfully grown, but at that early period little thought was given to commercial orchards and most of the fruit was grown for home use.

Industry was largely confined to the growing of wheat and vegetables, to which the region was discovered to be well adapted. The Blue mountains, adjacent to the valley, rise to a height of about 5,000 feet.

In recent years artesian wells have been sunk, which furnish at small cost an abundant supply of water with unusually heavy pressure.

Commercial fruit growing has become a considerable industry in recent years.

Wenatchee

Wenatchee valley is small, but for the quality of its apples it has never been excelled. It has a soil peculiarly adapted to the growing of the best commercial winter varieties. It is a volcanic ash common to all the region east of the Cascade range and west of the Rockies. But in this particular section there is a strong admixture of iron which is favorable to the production of the best grades of apples. The tendency of fruit growing in this district is more toward apples than in any other direction, for in this fruit the orchardists have found their greatest profits.

Yakima Valley

The Yakima valley is at present the largest fruit-growing district in the state of Washington. The Government has built dams at the outlets of the lakes, in order to impound water for the supply of the present irrigated areas, and also for a much larger area of land than is at present under any irrigating system. In addition to the irrigating systems from "gravity flow ditches and canals," there are several sections where artesian water is being used. The farming district in the "Upper Yakima valley" begins near Ellensburg, and from this point to Kennewick, at the mouth of the Yakima river, is about 150 miles. The width of the valley is hard to estimate, because it is so irregular; from a broad plain, as in the case of the Yakima Indian reservation, to narrow gorges, as in the case of Union and Selah gaps. In this valley, the great varieties of soil, climate, altitude and wind currents, make it possible to grow successfully for commercial purposes many varieties of fruits. For instance, at Kennewick, on the Columbia, near the mouth of the Yakima, the season is about two weeks earlier than at North Yakima, and about three weeks earlier than at Ellensburg. At Kennewick, the conditions are favorable for the growing of strawberries, blackberries, raspberries, grapes, peaches and pears. Strawberries can be ripened for the early markets. As we proceed further up the valley, the spring seasons are later, and the climate better adapted to the growing of commercial apples. In the vicinity of North Yakima, the conditions are ideal for the growing of such varieties of winter apples as the Winesap, Spitzenburg and Yellow Newtown; while further toward the mountains, or on the higher elevations, the conditions are equally good for the growing of Jonathan, Rome Beauty, Delicious and Wagener.

Yakima Valley Soils

Yakima farmers have, in the conservation of nitrogen in their soil, a problem before them equally as important as the proper marketing of their fruit. Productive as is the basaltic ash, and remarkable as are the crops, the fact remains that, according to chemical analyses carried on by the state college at Pullman, Yakima county soils show a decided shortage of that most important plant food, nitrogen. Indeed, only two counties in the state, Benton and Grant, have less. For King county the nitrogen

is 14 to 1 as compared with the Yakima valley.

Prof. Thatcher thinks that "by plowing under each year the leaves which fall from the trees, the nitrogen supply may be prolonged, since the leaves carry more than half the nitrogen taken from the soil. To replace the supply, however, in quantities sufficient to prevent the soil from becoming impoverished, it is necessary to plant and plow under leguminous, nitrogen-gathering crops.

"In lime Yakima soil is stronger than any in the state except Okanogan, Mason and Benton counties. While lime is not of the highest importance as a plant food, it exercises very beneficial effects upon the physical properties of the soil and the ease of tilth and upon the processes which make plant food available. In phosphoric acid, this county has 5,320 pounds per acre, which is hardly up to the average of other counties. Of potash there are 8,920 pounds, which is only about one-half or one-third as much as is contained in the soil of nearly all the other east side counties, though generally more than is to be found on the west side. Island county has in places 27,040 pounds to the acre and Benton 15,340.

What a Chemical Analysis Shows

"While a chemical analysis shows the percentage of plant food elements in the soil, it does not show the proportion of this total plant food supply in such form as to indicate what crops are best suited for that particular section. It does not show whether there is a sufficient supply of available plant food for immediate crop needs; nor does it throw much light upon many other questions about which a land owner or prospective purchaser is concerned. The growth of any given crop upon any piece of land depends much more upon elevation, moisture supply, air and moisture drainage, physical conditions of the soil, etc., than it does upon the chemical composition of the soil.

Leaves Hearty Eaters

"Experiments, however, showing the amount of food elements taken from the ground by various crops have been made, and prove interesting reading. A wheat crop, 50 bushels to the acre, takes from the soil 40 pounds of potash, 30 of phosphoric acid, and 100 of nitrogen. The basaltic loam of Adams county, therefore, contains enough potash to grow 430 crops of such wheat, phosphoric acid enough for 108 such crops and nitrogen enough for only 26. Obviously, therefore, nitrogen is the limiting factor in wheat production in that soil.

"Similarly the fine sandy soil of the Yakima valley shows enough potash for 68 crops of 600 boxes each of apples, phosphoric acid enough for 160 crops and only nitrogen enough for 12 such crops. On the other hand the same soil, if cropped to alfalfa, which draws practically its entire nitrogen supply from the air, would be exhausted of its potash by 52 crops of eight tons each of alfalfa hay, while carrying enough phosphoric acid for 65 such crops.

"A whole apple crop of 600 boxes of fruit per acre takes from the soil 134 pounds of potash, 33 of phosphoric acid and 112 of nitrogen. Of this the tree growth requires 7 pounds of potash, five of phosphoric acid and 6 of nitrogen; the leaves, estimated at four tons, 71 pounds of potash, 16 of phosphorus and 59 of nitrogen, leaving for the apples proper 56 pounds of potash, 12 of phosphorus and 47 of nitrogen. Potatoes, 300 bushels to the acre, exhaust the soil to the extent of 600 pounds of potash, 22 of phosphoric acid and 80 of nitrogen."

GRANVILLE LOWTHER

Plant Food in Washington Soils

In tables 1 and 2 are presented the number of pounds per acre of each of the four important plant-food constituents in the top foot of soil in each of the types of soil more commonly found in the different parts of the state, as computed from the results of our analyses of samples representing that type. In nearly every case several samples of the same type from adjacent localities within the

same county have been analyzed and the results presented are computed from the averages of these analyses. In many counties of the state several distinct types of soil are to be found, sometimes lying in fairly distinct areas of considerable size, but frequently more or less intermingled or overlapping. In each county, those types which are thought to be most representative and likely to be most easily recognized, or most commonly met with, are included in the tables. Information as to the composition of types not included in the tables may generally be obtained by correspondence with the station chemist.

Table I—Plant Food in Soils—Eastern Washington

COUNTY	Type of soil	Lime	Potash	Phosphoric acid	Nitrogen
Adams	Basaltic loam	24,180	17,220	3,240	2,660
Asotin	Snake River benches	21,760	15,720	2,210	3,280
Benton	Yakima fine sand	62,800	13,160	4,200	1,280
	Kennewick coarse sand	41,960	15,340	2,680	1,320
	Columbia River benches	62,800	13,340	Trace	1,070
Chelan	Wenatchee River benches	31,320	9,920	9,320	2,760
Columbia	Basaltic loam	30,200	18,680	4,400	2,680
	Touchet Valley bottom	32,680	16,360	6,280	4,940
Douglas	Basaltic loam	26,600	14,800	5,440	2,680
Ferry	Upland loam (pine land)	34,600	14,120	9,960	9,640
Franklin	Columbia River benches	47,000	16,600	13,520	5,560
Garfield	Basaltic loam	29,040	22,680	5,080	6,560
Grant	Winchester sand	44,800	12,480	2,000	1,040
Kittitas	Valley loam	46,800	18,840	4,480	5,400
Klickitat	Upland loam	22,080	8,520	3,610	3,160
Lincoln	Basaltic loam	30,800	18,440	5,680	5,040
Okanogan	River benches	83,750	13,170	7,150	2,770
Spokane	Gravelly benches	7,165	5,580	840	2,930
	Upland prairie	24,680	18,120	8,880	5,360
Stevens	Upland bench loam	21,040	12,280	9,400	2,760
Walla Walla	Volcanic ash loam	37,180	14,120	11,140	3,640
	Valley sandy loam	37,360	16,780	5,680	6,880
Whitman	Basaltic loam	27,920	19,080	13,400	7,120
Yakima	Yakima fine sand	57,640	8,920	5,320	1,480

Table II—Plant Food in Soils—Western Washington

COUNTY	Type of soil	Lime	Potash	Phosphoric acid	Nitrogen
Chehalis	Heavy clay loam	15,720	5,760	15,600	10,720
Clallam	Sandy benches	20,100	6,160	9,600	8,400
Clarke	Sandy loam	17,960	10,720	13,280	10,280
Island	Ebey's prairie loam	48,560	27,040	13,760	9,200
Jefferson	Clay loam	6,160	600	3,600	6,600
King	Alder bottom land	34,130	5,440	7,740	14,990
	Vashon Island loam	22,820	4,920	3,680	3,450
Kitsap	Clay loam	20,000	4,100	1,480	4,150
Lewis	Beaver dam	18,000	6,960	3,380	12,720
	Upland clay loam	21,160	5,560	7,200	9,280
Mason	Bottom land	61,000	6,640	6,200	12,960
Pierce	Alluvial loam	3,400	4,450	6,500	6,560
San Juan	Upland clay loam	20,900	1,840	7,470	4,720
Skagit	Tide flats	19,840	4,280	10,180	13,480
	Upland clay loam	21,060	4,980	8,760	3,900
Snohomish	Upland loam	27,780	5,650	9,370	3,340
Thurston	Prairie sandy loam	13,910	4,570	9,870	10,810
Wahkiakum	River bottom land	30,840	14,640	5,050	14,280
Whatcom	Upland clay loam	27,360	9,780	7,960	8,680
	Alder bottom land	33,120	8,760	6,280	7,200

Practical Ratings of Soil

While the composition of the soil is not necessarily a certain index of its crop-producing ability, a knowledge of its plant food content makes it possible to compare it with other soils of known fertility, and so get a fairly accurate idea of its probable relative grade or value for agricultural purposes. As a result of long-continued study of this subject the

following table (Table III) for practical rating of soil from its chemical composition has been devised. The table as originally prepared by Prof. Maercker, of the celebrated Halle Experiment Station, of Germany, is expressed in terms of percentages of the several elements, but these have been computed as pounds per acre-foot in order to facilitate comparison with the other tables of this bulletin.

Table III—Practical Ratings of Soils by Content of Plant Food—Plant Food Computed in Pounds per Acre of Top Foot of Soil

Grade of soil	Lime		Potash	Phosphoric acid	Nitrogen
	Clay soil	Sandy soil			
Poor	Below 4,000	Below 2,000	Below 2,000	Below 2,000	Below 2,000
Medium	4,000–10,000	2,000– 4,000	2,000– 6,000	2,000– 4,000	2,000– 4,000
Normal	10,000–20,000	4,000– 8,000	6,000–10,000	4,000– 6,000	4,000– 6,000
Good	20,000–40,000	8,000–12,000	10,000–16,000	6,000–10,000	6,000–10,000
Rich	Above 40,000	Above 12,000	Above 16,000	Above 10,000	Above 10,000

The ratings presented in this table have been so generally accepted by soil chemists, even those whose methods of analyses differ considerably, that they may be accepted as of general applicability to the soils of the temperate zone. As judged by this table, for example, the basaltic loam soil, so prevalent over Southeastern Washington, is generally rich in lime and potash, above normal in phosphoric acid and medium or poor in nitrogen. Similarly, the common clay loam of Western Washington is generally below normal in lime and potash, rich in phosphoric acid and normal to rich in nitrogen. R. W. THATCHER,

Director Washington Experiment Station.

Fruits for Washington

Recommended by Washington State College, Department of Horticulture, for Eastern Washington. The letters (E) (M) and (L) indicate the season of ripening, whether early, midseason or late.

Apples

For the irrigated valleys, Delicious (L), Duchess (M), Gravenstein (M), Grimes Golden (L), Jonathan (L), King (M), Rome Beauty (L), Spitzenburg (L), White Winter Pearmain (L), Winesap (L), Winter Banana (L), Yellow Newtown (L), Yellow Transparent (E). For upland orchards, Delicious (L), Duchess (M), Gano (L), Gravenstein (M), Jonathan (L), King (M), Rome Beauty (L), Wagener (L), Wealthy (M), White Winter Pearmain (L), Winter Banana (L), Yellow Transparent (E), York Imperial (L).

Apricots

For irrigated valleys, Early Golden (E), Hem-shirke (M), Moorpack (E), Royal (M). For upland orchards, Gibb (E) and Moorpack (E).

Sweet Cherries

For irrigated valleys Bing (M), Black Republican (L), Hoskins (L), Lambert (L). For upland orchards, Bing (M), Centennial (M), Hoskins (L), Lambert (L), Vilne Sweet.

Sour Cherries and Dukes

Early Richmond (E), Montmorency (M), Northwest (L), Olivet (M), May Duke, Late Duke, Reine Hortense.

Peaches

For irrigated valleys, Early Crawford (E), Elberta (M), Foster (M), Hale (E), Hill's Chili (M), Late Crawford (L), Salway (L), Wheatland (M). For upland orchards, Alexander (E), Champion (E), Early Crawford (E), Foster (E), Hale (E), Triumph (E), Wonderful (M).

Pears

Anjou (M), Bartlett (E), Clairgeau (L), Comice (M), Flemish (M), Seckel (M), White Doyenne (M), Winter Nelis (L).

Plums

Abundance, Bradshaw, Peach and Wickson.

Prunes

Hungarian, Italian and Silver.

Frost and Precipitation in Washington

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Tatoosh Island	Dec. 9	Mar. 13	Nov. 1	April 19	93.9
Olga	Nov. 13	Mar. 21	Sept. 21	April 11	30.7
Snohomish	Oct. 21	April 21	Sept. 21	July 12	46.7
Lakeside	Oct. 21	April 8	Oct. 3	April 21	12.7
Waterville	Sept. 16	June 1	Aug. 26	June 25	13.3
Spokane	Oct. 12	Mar. 21	Sept. 7	June 8	18.3
Seattle	Nov. 22	Mar. 21	Oct. 23	Mar. 10	37.0
Aberdeen	Nov. 1	April 19	Sept. 25	May 6	88.7
Olympia	Nov. 5	April 16	Sept. 21	May 14	55.1
Ellensburg	Sept. 20	May 23	Sept. 6	June 6	9.3
Colfax	Sept. 11	May 17	July 24	June 8	24.0
Centralia	Oct. 25	April 30	Oct. 7	June 3	46.4
Moxee Wells*	Sept. 21	May 23	Sept. 6	June 14	8.9
Pomeroy	Sept. 28	April 26	Sept. 6	May 24	19.4
Walla Walla	Nov. 1	April 6	Sept. 28	May 3	17.7
Lyle	Oct. 17	April 19	Sept. 21	May 7	27.2
Wenatchee	Oct. 21	April 30	Oct. 1	May 21	14.33
Kennewick	Oct. 15	April 28	Sept. 25	May 25	6.34
Lakeside	Oct. 19	April 10	Sept. 25	May 4	12.45
Conconully	Sept. 21	May 18	Sept. 10	June 23	16.14
Sunnyside	Oct. 8	May 7	Sept. 25	June 2	6.65

* Near North Yakima and, according to Special Frost Forecaster Reed, the coldest spot in the vicinity.—Ed.

Production of Fruits in Washington

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits total	.....	5,508	2,845	13,490,930	$941,415
Strawberries	4,323	3,283	1,268	7,683,774	529,535
Blackberries and dewberries	1,818	769	388	2,340,779	159,094
Raspberries and loganberries	3,615	1,210	625	3,118,720	223,001
Currants	1,287	127	238	194,365	16,518
Gooseberries	1,199	114	211	143,264	12,285
Cranberries	4	5	5	9,728	953
Other berries	3	(1)	110	300	29

[1] Reported in small fractions.

Strawberries are by far the most important of the small fruits raised in Washington, with raspberries and loganberries and blackberries and dewberries ranking second and third, respectively. The total acreage of small fruits in 1909 was 5,508 and in 1899 2,845, an increase of 93.6 per cent. The production in 1909 was 13,491,000 quarts, as compared with 5,407,000 quarts in 1899, while the value was $941,000 in 1909, as compared with $327,000 in 1899.

Orchard fruits, grapes and nuts: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is

on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	...	4,944,889	...	6,951,251	4,244,670	$4,274,124	1,180,357
Apples	27,156	3,009,337	21,401	4,862,702	2,672,100	2,925,761	728,978
Peaches and nectarines	7,139	536,875	8,199	1,028,141	84,494	118,918	80,990
Pears	20,343	290,676	13,752	617,754	310,804	328,895	78,236
Plums and prunes	20,329	823,082	10,508	122,912	1,032,077	600,503	229,207
Cherries	19,716	241,038	13,703	229,067	131,392	278,547	52,114
Apricots	3,623	36,088	3,294	80,722	10,789	17,280	5,254
Quinces	2,555	7,628	1,928	9,689	3,008	4,198	(2)
Mulberries	14	165	19	264	6	22	(2)
Unclassified	...	...	...	...	...	...	[3] 5,578
Grapes	2,121	322,007	2,212	371,733	1,704,005	51,412	1,194,700
Nuts, total	...	[4] 7,107	...	[4] 36,854	[4] 65,441	[4] 3,522	14,780
Persian or English walnuts	509	3,651	1,461	23,406	16,450	2,241	1,860
Almonds	149	695	293	8,800	770	86	4,800
Pecans	12	34	35	140	...	...	20
Black walnuts	104	1,427	76	601	43,438	687	(2)
Unclassified	...	...	...	...	...	...	[3] 8,100

[1] Expressed in bushels for orchard fruits, and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes butternuts, chestnuts, filberts, hazelnuts, beechnuts, hickory nuts, Japanese walnuts and other nuts.

The total quantity of orchard fruits produced in 1909 was 4,245,000 bushels, valued at $4,274,000. Apples contributed considerably more than one-half of this quantity; plums and prunes most of the remainder. The production of grapes in 1909 amounted to 1,704,005 pounds, valued at $51,412, and that of nuts to 65,441 pounds, valued at $3,522.

The production of all orchard fruits together in 1909 was 259.6 per cent greater than in 1899, and the production of grapes also increased. The value of orchard fruits increased from $999,000 in 1899 to $4,274,000 in 1909, and that of grapes from $27,242 in 1899 to $51,412 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	1,347	2 4	Gals	98,050	34,713
Vinegar	982	1.7	Gals	62,446	13,104
Wine and grape juice	136	0 2	Gals	5,891	4,973
Dried fruits	490	0 9	Lbs	1,842,306	253,720

WASTE IN MARKETING, REDUCTION OF, see *Marketing*.

Watermelon

The watermelon is a native of Africa. It is very different in appearance, and in the character of its fruit, from the muskmelon. There are many varieties, but the characteristics of the varieties are not so different as those of the muskmelon. The watermelon has a very compact and shell-like rind, a little like the shell of a gourd, and which holds water with but little evaporation from its surface. For this reason watermelons can be grown more successfully on a dry soil, in a semi-arid climate, than muskmelons, pumpkins, or squashes. The soil best adapted to the growing of watermelons is a sandy loam. The climate best adapted is one without too much rain, say about 20 to 25 inches. In sections where irrigation is practiced, care should be used not to give them too much water.

The edible part of the flesh ranges in color from cream to deep red, and the color of the rind is from very light to dark green.

GRANVILLE LOWTHER

Growing Watermelons

Depth to Plant

Where irrigation is practiced and where the humidity of the atmosphere is low, the depth at which the seeds are planted is somewhat greater than it is in the humid regions. If the seed is planted in very shallow soil, frequently it will not come up on account of the soil losing so much of its moisture before germination takes place. In such cases it is necessary to irrigate again in order that the young plants may come through the soil. The usual depth varies from one and a half inches to three inches. The depth depends on the texture and moisture condition of the soil.

Thinning

If all, or almost all, of the seeds planted in the hills germinate, it is necessary to thin them out before they get too large. If all of the little seedlings are allowed to grow, the vines will tend to crowd each other, which will result in weak plants and poor crops of inferior quality. It is advisable to thin twice. The first time, only thin to about four plants to the hill. This is a safeguard against mice and squirrels or insects that sometimes destroy some of the plants in the hill. At the last thinning, which should be done about the time the plants begin to send out runners, all but two plants to each hill should be removed. It is better to have one or two plants to the hill than more.

Distance Apart to Plant

The distance at which to plant the seed varies with the variety and with the fertility of the soil. If the soil is quite rich the distance should be greater. The common practice followed on ordinary soils is to plant the seeds from seven to nine feet apart in the row. The distance between the hills in the row is always less than the distance or width of middles between the ditch borders. The closer the hills are planted in the row, the wider should be the middles.

According to our system of growing watermelons more hills can be grown to the acre than by the Eastern method. In the following table the number of hills per acre at different distances is given:

Width of ditch	Width of middles	Number of hills per acre at		
		7 feet between	8 feet hills	9 feet in row
3 feet	9 feet	1037	907	806
3 feet	10 feet	957	837	744
3 feet	11 feet	888	777	691
3 feet	12 feet	829	726	645
4 feet	9 feet	957	837	744
4 feet	10 feet	888	777	691
4 feet	11 feet	829	837	744
4 feet	12 feet	777	780	605

Training the Vines

The training should be begun just as soon as the vines begin to make runners. The runners are never allowed to remain in the ditches. By training the vines back on the dry middles the melons are always on dry soil and the chances for the decay that might result from the melons resting on wet soil are considerably lessened. It is often necessary to go over the field three or more times during the earlier part of the season and turn the vines over on the higher and dry middles. This makes it necessary to handle the vines more, perhaps, than is desirable for the good of the plant. The gardner should be careful in doing the work not to injure the vines more than necessary. Some melon growers in the humid sections do not favor the practice of turning the vines. One author writes as follows:

"Never, under any circumstances, turn a vine! More will be lost by so doing than will be gained by giving the plant an extra cultivation. This is another ancestral practice and doubtless arises from the fact that vines when turned are apt to be carelessly handled. If returned gently and deftly to their original position, it is difficult to realize how they would be injured. Any weeding that is found necessary after this time should be effected with a scythe blade, lopping off the tops of the weeds above the vines. They should not even be pulled out by hand, on account of the danger of mutilating the vines, which generally hold them in a tight embrace with their tendrils. Indeed, rather than risk disturbing a vine it would be preferable to leave the weeds and the melons to 'have it out' between them; for a few well-anchored weeds, here and there, prove rather a benefit than a detriment, since they prevent the winds from rolling up and matting the vines."*

Cultivation

The cultivation of the watermelon is very simple. It consists in hoeing the weeds in the ditches and around the vine during its earlier growth, and in occasionally drawing up the soil to the vine with the hoe from the inside of the ditch. The middles are cultivated during the early part of the season; and as soon as the runners get large enough to take up a considerable part of the middles, cultivation is stopped. Since the middles are never irrigated, very few weeds grow in the middles. If, after cultivation has stopped, the middles get weedy, the large weeds can be pulled up by hand or they may be cut off with a scythe.

How to Tell a Ripe Melon

The knowledge of telling a ripe melon comes mainly by experience and observation. It is often claimed that when the little "curl" or tendril on the stem is dead, the melon is ripe; if green, the melon is also green. This is not altogether a reliable sign. The flat, dead sound emitted by the melon when thumped with the finger is also an indication of ripeness. If on turning the melon over and exposing the under side, the white blotches are found yellowish, rough and warty with the surface sufficiently hard to resist the finger nails when scratched, it is another sign of ripeness. After the melon looks ripe and thumps as if it were ripe, and if on pressing it down the interior appears to give, and this is also accompanied by a slight crisp crackling, the melon is almost sure to be ripe. Melons that are to be shipped should not be put to this latter test.

FABIAN GARCIA,
Santa Fe, N. M.

WATERMELON DISEASES

DAMPING-OFF or RHIZOCTONIA, see *Cucumber Diseases.*

Leaf Diseases

ANTHRACNOSE, DOWNY MILDEW, LEAF MOULD, LEAF SPOT, see *Cucumber* and *Cantaloup Diseases.*

Wilt

Fusarium

F. D. BAILEY

The fungous wilt of watermelons is a disease that causes great loss in certain

* Georgia Experiment Station Bulletin 38, p. 75, by Hugh N. Stearns.

sections of the country. Once established in a field, it will live there for years and kill off the plants whenever watermelons are planted in it.

The disease is quite generally distributed throughout the southeastern part of the United States and has been reported from Iowa, Indiana, Arizona, Oklahoma and California. It is also destructive in some parts of Oregon.

Symptoms

The name indicates the characteristic symptoms, the wilting and drooping of the foliage as though the water supply were cut off (Fig. 1). This wilting comes on suddenly and in a very short time the plant is dead. If the main stem of a wilted plant be cut in cross section, the woody part is found to be yellow and discolored, making a marked contrast with the normal plant in which the tissues are uniformally white. Sometimes a pinkish, mold-like growth comes out on the surface of the stem soon after the plant is killed, extending for a foot or more up the stem from the crown.

Cause

This wilt is caused by a Fusarium, a fungus which is capable of living in the soil for several years, and may attack any melon plants that are afterwards planted in fields where it exists. This fungus is composed of a very delicate, branching thread-like growth, so delicate, indeed, that its presence could not be detected in the soil. This growth, on coming in contact with the tender roots of the melon plant, is able to penetrate them, and, once within the tissues of the plant, it finds the proper nourishment for rapid growth. Very small spores are produced and set free in the vessels, where they germinate to start new points of infection. These spores, having germinated, produce a growth which plugs up the vessels and so prevents sap flow. This condition results in wilt and in the death of the plant. The fungus rapidly spreads through the roots and older part of the vine, often coming to the surface where another and larger kind of spore than those formed within the vessels may be produced in great numbers. These spores are readily carried by wind or insects, thus helping to scatter the disease over wide areas.

Another way in which this disease is frequently spread to new fields is through the application of manure. Diseased plants frequently are carried to the compost heap. It is also claimed that the fungus spores are not killed when passing through the alimentary canal of cattle. It is, therefore, necessary to avoid any chance for cattle to pasture on wilted vines.

Treatment

Take every precaution, in the first place, to keep the disease from spreading to new fields. Tools used in a field where the disease is found should be cleaned and sterilized before using them in ground free from trouble. Do not drive or walk directly from the one to the other or allow soil to be transferred, as might be the case where irrigation is practiced. Keep the compost heap free from the fungus. If doubtful on this point, it would be advisable to try fertilizing a

Fig. 1. Watermelon Wilt, a Serious Disease in Some Sections. This disease is caused by a soil fungus

few isolated plants for a year before taking a chance of infecting new fields.

When the disease appears in a patch the plants affected should be removed and burned as soon as they are discovered.

In districts where this wilt is already widespread and the further culture of melons is desirable, the only course open to the grower is to secure a resistant strain by breeding and selecting. It has been found that these resistant strains can rarely be transferred to new localities and still retain their resistance. The problem, therefore, becomes an individual one for each section of the country. The task will take several years and it will be necessary to devote several acres of good melon soil to the work in order to secure the desired results.

The experimental work consists in crossing the watermelon with the citron, which is more hardy and resistant to the wilt. By following the breeding with careful selection, a resistant melon having good flavor and shipping qualities can be developed.

WATERMELON PESTS

Banded Leaf-Footed Plant Bug, see *Cucumber Pests.*

Common Squash Bug, see *Squash Pests.*

Melon Aphids, see *Aphids.*

Melon Fly

Dacus cucurbitae

This important pest is a near kinsman of the much-feared Mediterranean fruit fly, against which a rigid quarantine is maintained in this country.

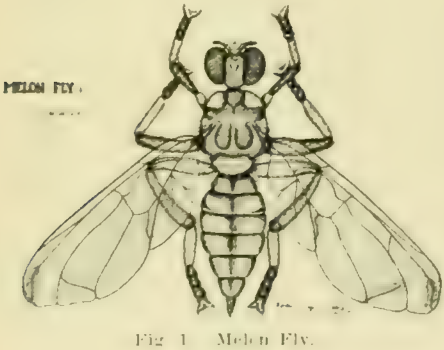


Fig. 1 Melon Fly.

The fly seems to have become distributed pretty well over the islands of the Pacific, and is frequently intercepted in fruit from Honolulu.

Growers should be on the watch for it.

Melon Worm, see *Cucumber Pests.*

Northern Leaf-Footed Plant Bug, see *Cucumber Pests.*

Plant Louse, see *Aphids.*

Pickle Worm, see *Cucumber Pests.*

Potato Flea Beetle, see *Potato Pests.*

Squash Lady Beetle, see *Squash Pests.*

Striped Cucumber Beetle, see *Cucumber Pests.*

Twelve-Spotted Beetle, see *Cucumber Pests.*

Water Required to Produce Certain Crops

A table showing the pounds of water required to produce a pound of dry matter has been worked out by Professor C. C. Thom, Soil Physicist at the Washington Experiment Station.

Kind of Crop	Pounds of Water
Potatoes	167
Sorghum	230
Onions	235
Corn	290
Barley	294
Carrots	297
Sugar Beets	304
Timothy	315
Oats	345
Tomatoes	350
Cabbage	398
Soy Beans	408
Alfalfa	414
Emmer	415
Canada Peas	444
Field Beans	444
Red Clover	448
Wheat	450

Water Rights, see *Irrigation.*

Water Supply for a Farm Home, see under *Farms.*

Water, How to Estimate Quantity of, see *Irrigation.*

Waxes for Grafting and for Wounds

I—Common Resin and Beeswax Waxes

1. Reliable Wax.—Resin, four parts by weight; beeswax, two parts; tallow, one part. Melt together and pour into a pail of cold water. Then grease the hands and pull the wax until it is nearly white. One of the best waxes, either for indoor or outdoor use.

2. Resin, four pounds; beeswax, one pound; tallow one pound.

3. Resin, six pounds; beeswax, two pounds; linseed oil, one pint.

4. Six pounds resin, one beeswax, and one pint linseed oil; apply hot with a brush, one-eighth of an inch thick over all the joints.

5. For Warm Weather.—Four pounds of resin, one pound of beeswax, and from half to a pint of raw linseed oil; melt together gradually, and turn into water and pull. The linseed oil should be entirely free from cotton-seed oil.

6. Resin, six parts; beeswax, one part; tallow, one part. To be used warm, in the house.

7. Resin, four or five parts; beeswax, one and one-half to two parts; linseed oil, one to one and one-half parts. For outdoor work.

II—Alcoholic Waxes

8. Lefert's Liquid Grafting Wax, or Alcoholic Plastic.—Best white resin, one pound; beef tallow, one ounce; remove from the fire and add eight ounces of alcohol. Keep in closed bottles or can.

9. Alcoholic Plastic with Beeswax.—Melt six parts white resin with one part beeswax; remove from stove and partially cool by stirring, then add gradually, with continued stirring, enough alcohol to make the mixture, when cool, of the consistency of porridge. In the temperature of the grafting-room it will remain sufficiently plastic to permit applying to the cut surfaces with the finger.

10. Alcoholic Plastic with Turpentine.—Best white resin, one pound; beef tallow, one ounce; turpentine, one teaspoonful; add enough alcohol (13 to 15 fluid ounces of 95 per cent alcohol) to make the wax of the consistency of honey. Or, less alcohol may be added if the wax is to be used with the fingers.

III—French and Pitch Waxes

11. Common French.—Pitch, one-half pound; beeswax, one-half pound; cow-dung, one pound. Boil together, melt, and apply with a brush.

12. Common French Bandage Wax.—Equal parts of beeswax, turpentine and resin. While warm spread on strips of coarse cotton or strong paper.

13. Grafting Clay.—One-third cow-dung, free from straw, and two-thirds clay, or clayey loam, with a little hair, like that used in plaster, to prevent its cracking. Beat and temper it for two or three days until it is thoroughly incorporated. When used it should be of such consistency as to be easily put on and shaped with the hands.

14. Two pounds 12 ounces of resin and one pound 11 ounces of Burgundy pitch. At the same time, melt nine ounces of tallow; pour the latter into the former, while both are hot, and stir the mixture thoroughly. Then add 18 ounces of red ochre, dropping it in gradually and stirring the mixture at the same time.

15. Black pitch, 28 parts; Burgundy pitch, 28 parts; beeswax, 16 parts; grease, 14 parts; yellow ochre, 14 parts.

16. Black pitch, 28 pounds; Burgundy pitch, 28 pounds; yellow wax, 16 pounds; suet or tallow, 14 pounds; sifted ashes, 14 pounds. When used, warm sufficiently to make it liquid.

17. Melt together one and one-fourth pounds of clear resin and three-fourths pound of white pitch. At the same time melt one-fourth pound of tallow. Pour the melted tallow into the first mixture, and stir vigorously. Then, before the stuff cools, add, slowly stirring meantime, one-half pound of Venetian red. This may be used warm or cold.

IV—Waxed String and Bandage

18. Waxed String for Root Grafting.—Into a kettle of melted wax place balls of No. 18 knitting cotton. Turn the balls frequently, and in five minutes they will

be thoroughly saturated, when they are dried and put away for further use.

This material is strong enough, and at the same time breaks so easily as not to injure the hands. Any of the resin and beeswax waxes may be used. When the string is used it should be warm enough to stick without tying.

19. Waxed Cloth.—Old calico or thin muslin is rolled on a stick and placed in melted wax. When saturated it is allowed to cool by being unrolled on a bench. It is then cut in strips to suit.

V—Waxes for Wounds

20. Any of the more adhesive grafting waxes are excellent for dressing wounds, although most of them cleave off after the first year. Stiff and ochreous paints are also good. Tar is useful.

21. Coal Tar.—Apply a coating of coal tar to the wound, which has first been pared and smoothed. If the wound contains a hole, plug it with seasoned wood.

22. Hoskins' Wax. — Boil pine tar slowly for three or four hours; add one-half pound of beeswax to a quart of the tar. Have ready some dry and finely sifted clay, and when the mixture of tar and wax is partly cold, stir into the above named quantity about 12 ounces of the clay; continue the stirring until the mixture is so stiff and so nearly cool that the clay will not settle. This is soft enough in mild weather to be easily applied with a knife or spatula.

23. Schaefell's Healing Paint. — Boil linseed oil (free from cotton-seed oil) one hour, with an ounce of litharge to each pint of oil; then stir in sifted wood ashes until the paint is of the proper consistency. Pare the bark until smooth, as the fuzzy edge left by the saw will cause it to die back. Paint the wound over in dry weather, and if the wound is very large cover with a gunny-sack.

24. Tar for Bleeding in Vines.—Add to tar about three or four times its weight of powdered slate or some similar substance.

25. Hot Iron for Bleeding in Vines.—Apply a hot iron to the bare surface until it is charred, and then rub into the charred surface a paste made of newly burnt lime and grease.

26. Collodion for Bleeding in Vines.—In some extreme cases two or three coats will be needed, in which case allow the collodion to form a film before applying another coat. Pharmaceutical collodion is better than photographic.

Bailey's Rule Book, pp. 86-89.

Other Formulae

Resin four or five parts, beeswax one and one-half to two parts, linseed oil one to one and one-half parts. This is melted in a mass, and when cool enough it may be drawn out into thin strips and applied by wrapping it firmly around the stock where the scion is inserted; or a more convenient mode of using this wax is to spread it while melted upon thin muslin or strong manila paper and, when cool, cut or tear in strips of convenient width for wrapping around the grafted stock.

Resin six pounds, beeswax one pound, linseed oil one pint. Melt together, and when at the temperature of 180 degrees F. apply directly to the joints with a small bristle brush. In order to keep it at the proper consistency the vessel containing the wax may be placed in another vessel containing boiling water.

G. B. Brackett.

Washington, D. C.

Weights of Apples, see under *Apple Packing*.

West Virginia

West Virginia is quite irregular in shape. Seven of its counties, viz., Jefferson, Berkshire, Morgan, Hampshire, Hardy, Mineral and Pendleton, are east of the Alleghany mountain range and their waters drain into the Potomac river. Four counties lie in a narrow strip, extending north from the main body of the state, along the Ohio river. These counties are Hancock, Brooke, Ohio and Marshall. In the region east of the Alleghany mountains are considerable deposits of limestone, which greatly improves the soil for agricultural and horticultural purposes. According to the

census of 1910, Berkeley county produced more apples than any of the counties of this section, or 246,508 bushels from 166,118 bearing trees. West of the mountains, extending to the Ohio river, is the main body of the state; hilly, in some places rugged; in others undulating, with beautiful valleys. Unlike most other states, the horticultural interests are somewhat evenly distributed, rather than being localized into one or two sections of the state. For instance, it is shown by the 1910 census that the counties with more than 100,000 bearing apple trees were Berkeley, Braxton, Hampshire, Harrison, Jackson, Kanawha, Marion, Mason, Monroe, Preston, Ritchie, Roane, Summers, Wayne, Wood. This shows that the concensus of opinion among the fruit growers of the state is that in favored locations in all parts of the state fruit growing is a profitable industry. However, the wealth of the state is in so large degree dependent upon oil, gas, and coal, and in many cases it has been so easy to realize large fortunes from these sources with but little labor, that all kinds of agricultural interests have been neglected in greater degree than they would otherwise have been.

In West Virginia, as in most other states, the tendency is toward commercial orcharding on a large scale. The smaller orchards are being neglected, and as a result fail to produce a high-grade fruit; but, except for home consumption, this tends to centralize the work into the hands of large dealers, or producers, who adopt the best methods and place on the markets fruits of high grade.

The drainage system of West Virginia, west of the Alleghanies, is mainly through the Little Kanawha, Great Kanawha, and Guyandotte, with a few smaller streams. These all empty, directly or indirectly, into the Ohio river. The upland soils are generally clay, but along the streams there is clay, sand and loam, with a mixture of disintegrated limestone.

The climate of West Virginia is not extreme, and the rainfall is abundant for the growing of all kinds of fruits commonly grown in the temperate climates. The principal crops are apples and peaches. Pears, plums, cherries, grapes and small fruits can be grown, but are not considered commercial crops, because they are grown mostly for home use and not for the markets.

Walnuts, chestnuts, hickory nuts, pecans, and others are indigenous to the soil, but are not grown in large quantities, and only walnuts have any commercial value.

Of the small fruits, strawberries, blackberries, raspberries and dewberries grow wild in great abundance. Grapes also grow wild in all parts of the state.

GRANVILLE LOWTHER

Frost and Precipitation for West Virginia

Station	No.	Frost: Average Date of: First Killing in Autumn	Frost: Average Date of: Last in Spring	Frost: Date of: First in Autumn	Frost: Date of: Last in Spring	Precipitation: Annual inches
Wellsburg....	1	Oct. 15	May 3	Oct. 1	May 10	40.2
Morgantown.	2	Oct. 13	April 30	Oct. 1	May 10	41.0
Terra Alta........	3	Oct. 5	May 6	Sept. 14	May 10	55.4
Burlington........	4	Sept. 29	April 29	Sept. 15	May 29	35.4
Martinsburg......	5	Oct. 20	April 16	Oct. 1	May 3	35.2
Parkersburg...	6	Oct. 17	April 11	Sept. 24	May 22	41.3
Lost Creek.......	7	Oct. 2	April 29	Sept. 14	May 8	43.5
Point Pleasant	8	Oct. 18	April 17	....	....	39.5
Glenville.........	9	Oct. 18	April 25	Oct. 1	May 29	46.9
Elkins	10	Oct. 11	April 28	Sept. 28	May 10	45.6
Powellton........	11	Oct. 12	April 23	Oct. 1	May 13	43.3
Marlinton........	12	Oct. 5	April 30	Sept. 21	May 28	45.7
Hillton..	13	Oct. 19	April 20	Oct. 5	May 10	38.4
Elkhorn..........	14	Oct. 17	April 24	Oct. 1	May 15	44.4

Production of Fruits in West Virginia

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total	...	2,913	1,994	2,336,562	$191,002
Strawberries	2,408	709	799	812,049	74,778
Blackberries and dewberries	3,829	1,292	367	803,498	48,854
Raspberries and loganberries	3,905	847	704	648,174	60,749
Currants	658	30	50	34,009	3,153
Gooseberries	784	30	59	35,632	3,238
Other berries	2	5	15	3,200	230

Strawberries are the most important in quantity and value of the small fruits raised in West Virginia, with blackberries and dewberries ranking second in quantity and third in value, while raspberries and loganberries are third in quantity but second in value. The total acreage of small fruits in 1909 was 2,913, and in 1899, 1,994, an increase of 46.1 per cent. The production in 1909 was 2,337,000 quarts, as compared with 2,388,000 quarts in 1899, and the value was $191,000 in 1909, as compared with $149,000 in 1899.

Orchard fruits, grapes, nuts and tropical fruits: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes, nuts and tropical fruits. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 4,710,000 bushels, valued at $3,040,000. Apples contributed about nine-tenths of this quantity, peaches and nectarines most of the remainder. The production of grapes in 1909 amounted to 3,224,751 pounds, valued at $92,834, and that of nuts to 974,312 pounds, valued at $16,049.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product 1909		Product 1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	...	6,770,384	...	4,589,587	4,709,959	$3,040,192	7,642,193
Apples	76,122	4,570,948	46,837	2,772,025	4,225,163	2,461,074	7,495,743
Peaches and nectarines	34,903	1,424,582	20,703	1,441,188	328,901	368,584	18,100
Pears	25,729	154,908	20,128	102,826	29,916	32,101	19,475
Plums and prunes	22,695	234,859	12,096	125,078	32,948	48,522	19,123
Cherries	30,539	332,429	12,277	124,567	79,723	111,043	87,828
Apricots	599	1,947	380	1,201	124	185	145
Quinces	10,439	50,708	4,027	22,702	13,163	18,676	(2)
Mulberries	2	3	...	...	21	7	(2)
Unclassified	...	...	...	...	...	...	[3] 1,779
Grapes	25,733	284,074	6,769	76,465	3,224,751	92,834	2,192,147
Nuts total	...	[4] 42,167	...	[4] 12,903	[4] 974,312	[4] 16,049	502,900
Persian or English walnuts	121	3,035	59	1,481	17,337	2,153	...
Black walnuts	1,337	32,495	225	9,682	878,215	11,430	(2)
Chestnuts	211	4,830	14	1,536	40,380	1,830	(2)
Unclassified	...	...	...	...	...	...	[3] 502,900
Tropical Fruits (figs)	26	225	17	1,428	950	47	..

[1] Expressed in bushels for orchard fruits and pounds for grapes, nuts and figs.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes hickory nuts, butternuts, almonds, pecans, chinquapins and other nuts.

The production of all orchard fruits together in 1909 was 38.4 per cent less in quantity than that in 1899, while the production of grapes increased materially. The value of orchard fruits, however, increased from $2,156,000 in 1899 to $3,040,000 in 1909, and that of grapes from $50,874 in 1899 to $92,834 in 1909. It should be noted that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produce d		
	Number	Per cent of all farms	Unit	1909	1899
Cider	3,516	3 6	Gals	248,543	903,830
Vinegar	4,195	4.3	Gals	122,592	284,729
Wine and grape juice	949	1 0	Gals	15,449	17,658
Dried fruits	5,792	6.0	Lbs	396,927	1,843,060

White Hickory. See *Hickory Nut.*

Whitman Apple Trees. See *History of Orcharding in Old Oregon*, p. 65.

Wind Breaks. See *Apple Orchard.*

Wisconsin

"Wisconsin is part of the inner margin of an ancient coastal plain and the old land of crystaline rocks about which the plain sediments were deposited. The plain and the old land were well worn down by erosion, and were then uplifted, dissected by stream valleys and were glaciated." The elevation of the state is from 500 to 1,940 feet, undulating, rather hilly in places, in others flat. The drainage system is mostly towards the Mississippi river, but a few small streams drain into lakes Superior and Michigan. Wisconsin has about 2,500 lakes, the largest of which is Winnebago, which is said to be the largest lake in the Union wholly within the boundary of one state.

The climate in winter is rather severe. Extremes at La Crosse within a period of 30 years have been 104 degrees above zero and 43 degrees below. The average annual precipitation is 31.5 inches.

The total number of bearing apple trees is reported as 2,430,232, being 95 per cent of all the orchard fruits produced in the state. Peaches are not grown for commercial purposes, and only in a few places for home use. Pears are grown in small quantities. Of cherries there are reported 290,000 trees; strawberries, 2,863 acres, and cranberries, 1,689 acres. Of nuts there are reported 40,789 trees.

The apple-growing section of the state has been grouped by Professor J. G. Moore into three divisions, as follows:

1. The Wisconsin valley section, including Sauk, Richland, Grant, Crawford and a part of Vernon counties.

2. The Lake Shore region, comprising the counties along the shore of Lake Michigan north of Milwaukee, including the Door peninsula.

3. The counties of Bayfield and Ashland, in the northern part of the state, protected by the lake, are developing into a good apple-producing section. Little was known of this region previous to 1905, but since that time there has been rapid development in the planting of trees.

Three other sections deserve mention as probable apple-producing centers. They are a part of Marathon county, the bluffs along the Mississippi river, and parts of Dunn, Eau Claire and Chippewa counties.

Granville Lowther

Frost and Precipitation for Wisconsin

Station	Frost: Average Date of First Killing in Autumn	Frost: Average Date of Last in Spring	Frost: Date of First in Autumn	Frost: Date of Last in Spring	Precipitation: Annual inches
Washburn....	Oct. 12	May 16	Sept. 25	June 5	29.8
Grantsburg..	Sept. 22	May 20	Sept. 9	June 7	31.1
Hayward..	Sept. 9	June 3	Aug. 9	June 30	32.8
Florence......	Sept. 10	June 1	Aug. 19	June 12	31.5
Osceola.......	Sept. 8	May 26	Aug. 27	June 12	32.7
Barron.......	Aug. 31	May 31	Aug. 6	June 29	30.0
Medford......	Sept. 11	June 2	July 29	June 30	33.3
Koepnick.....	Sept. 15	May 9	Aug. 12	June 24	34.9
Eau Claire..	Sept. 26	May 17	Sept. 11	June 12	33.7
Neilsville.....	Sept. 16	May 25	Aug. 29	June 12	34.2
Stevens Point	Sept. 22	May 24	Sept. 9	June 30	28.0
Oconto.......	Sept. 29	May 14	Sept. 14	June 5	29.3
Green Bay....	Oct. 4	May 5	Sept. 16	May 30	31.0
Hancock...	Sept. 24	May 16	Sept. 12	June 12	28.3
Fon du Lac.	Sept. 29	May 11	Sept. 12	May 27	26.2
Manitowoc .	Oct. 11	May 12	Sept. 24	May 31	30.0
La Crosse....	Oct. 8	May 2	Sept. 21	June 23	30.9
Viroqua......	Sept. 26	May 6	Sept. 12	June 12	36.4
Lancaster.....	Sept. 29	May 8	Sept. 12	June 12	29.7
Madison......	Oct. 17	April 21	Sept. 30	May 13	31.9
Harvey.......	Oct. 1	May 4	Sept. 20	June 6	31.9
Milwaukee....	Oct. 10	April 29	Sept. 25	May 29	31.0
Beloit........	Oct. 10	April 23	Sept. 27	May 20	32.8

Production of Fruits in Wisconsin

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres 1909	Acres 1899	Quantity (quarts) 1909	Value 1909
Small Fruits, total		6,305	12,389	9,782,779	$765,437
Strawberries	12,084	2,863	3,508	5,188,117	434,971
Blackberries and dewberries	2,272	407	411	498,119	48,707
Raspberries and loganberries	6,132	964	1,616	1,053,889	114,578
Currants	3,853	298	667	383,982	31,078
Gooseberries	1,841	82	177	107,708	8,751
Cranberries	229	1,689	5,821	2,549,344	127,212
Other berries	3	2	189	1,620	140

Strawberries are by far the most important of the small fruits raised in Wisconsin, with cranberries ranking next and raspberries and loganberries third. The total acreage of small fruits in 1909 was 6,305 and in 1899, 12,389, a decrease of 49.1 per cent. The production in 1909 was 9,783,000 quarts, as compared with 15,459,000 quarts in 1899, and the value $765,000, as compared with $835,000.

Orchard fruits, grapes and nuts: 1909 and 1899. The next table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses

of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

The total quantity of orchard fruits produced in 1909 was 2,344,000 bushels, valued at $2,087,000. Apples contributed about 95 per cent of this quantity; cherries most of the remainder. The production of grapes in 1909 amounted to 701,329 pounds, valued at $25,537, and that of nuts to 609,428 pounds, valued at $18,196. The nuts consisted mostly of hickory nuts.

The production of all orchard fruits together in 1909 was nearly seven times as great in quantity as that in 1899, and the production of grapes also increased materially. The value of orchard fruits increased from $267,000 in 1899 to $2,087,000 in 1909, and that of grapes from $15,173 in 1899 to $25,537 in 1909. It should be noted in this connection that the values for 1899 include the value of more advanced products derived from orchard fruits or grapes, such as cider, vinegar, dried fruits and the like, and may therefore involve some duplication, while the values shown for 1909 relate only to the products in their original condition.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits total		2,861,830	....	1,654,616	2,343,517	$2,087,202	348,600
Apples	101,181	2,430,232	71,967	1,408,726	2,232,112	2,896,681	303,373
Peaches and nectarines	524	4,163	596	4,148	956	552	209
Pears	7,734	29,841	5,315	20,250	12,992	16,551	1,540
Plums and prunes	13,542	105,909	10,741	71,153	15,907	20,944	12,166
Cherries	32,130	290,495	13,209	148,775	81,340	152,119	31,067
Apricots	178	593	114	354	100	211	57
Quinces	77	581	69	1,203	90	114	(2)
Mulberries	7	16	4	7	20	30	(2)
Unclassified							[3] 188
Grapes	7,422	148,348	3,150	63,098	701,329	25,537	571,459
Nuts, total		[4] 40,789		5,344	[4] 609,428	[4] 18,196	80,150
Black walnuts	333	3,459	71	922	86,086	1,617	(2)
Butternuts	127	1,111	18	70	20,310	450	(2)
Hickory nuts	2,391	35,702	84	4,352	496,722	15,954	(2)
Unclassified			...		...	......	[3] 80,150

[1] Expressed in bushels for orchard fruits and pounds for grapes and nuts.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes almonds, hazelnuts, chestnuts and other nuts.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule.

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	2,665	1.5	Gals.......	169,150	19,026
Vinegar	515	0.3	Gals.	16,472	10,111
Wine and grape juice	2,051	1.2	Gals	33,785	45,783
Dried fruit	311	0.2	Lbs........	8,644	2,670

Wyoming

Wyoming has an area of 97,800 square miles. The Rocky mountain system, with its spurs, traverses the state, and the average elevation is about 6,000 feet. There are peaks rising to a height of from 10,000 to 14,000 feet. The Black Hills, in the northeastern portion, and the Uintah mountains, in the southwest, form the principal groups. In the northern part are the Big Horn mountains, and in the northwest are the Teton, Gros Ventre, Sanke River and Owl Creek mountains. In the southeast are the Laramie, Medicine Bow, Seminole, Rattlesnake, Sheep and Snow mountains. The principal plains are the Laramie, the Platte, the Cheyenne, in the east and southeast, and the Red Desert, in the southwest.

Great rivers and drainage systems rise in the state.

Every age of geological formation may be found in Wyoming.

The extremes of temperature show 116 degrees above zero and 44 degrees below.

In the valleys the soil is a dark fertile lime. In the hills there is a large admixture of sand, and in some places these highlands are fertile. In the Red Desert region there are large deposits of alkali and other saline substances that render the land practically useless.

Irrigation is practiced in many parts of the state and is necessary, except along the streams, in order to successfully grow crops of any kind. More than half the total area of Wyoming is above 6,000 feet in altitude, and therefore at too great a height for the growing of fruits. There are a few favored places protected from winds, with air drainage and low altitudes, where fruits can be successfully grown, which are of fine quality; but the present outlook is that Wyoming will tend much more to the production of other crops, to which it is better adapted than to fruit. However, with a better knowledge of adaptation of varieties to conditions, there are sections where fruit of all the hardier kinds can be profitably grown for commercial purposes.

GRANVILLE LOWTHER

Frost and Precipitation for Wyoming

Station	Frost				Precipitation
	Average Date of		Date of		
	First Killing in Autumn	Last in Spring	First in Autumn	Last in Spring	Annual inches
Yellowstone Park					19.6
Four Bear					11.3
Basin	Sept. 12	May 13	Sept. 5	June 9	5.3
Buffalo	Sept. 18	June 2	Sept. 9	June 21	11.1
Thayne					14.3
Lander	Sept. 11	May 29	Aug. 23	June 18	13.4
Alcova	Sept. 12	May 25	Aug. 23	June 15	9.4
Luck	Sept. 14	May 25	Sept. 5	June 20	12.9
Fort Laramie					11.1
Rawlins	Sept. 16	June 5	Sept. 8	June 13	12.9
Evanston					13.1
Laramie	Sept. 11	May 31	Aug. 16	June 18	9.9
Cheyenne	Sept. 16	May 22	Aug. 29	June 11	13.1

Production of Fruits and Vegetables in Wyoming

Vegetables, flowers and plants, and nursery products: 1909 and 1899. The table which follows shows details with regard to vegetables (not including potatoes and sweet potatoes and yams, which appear elsewhere), and also with regard to flowers and plants and nursery products:

CROP	Farms reporting, 1909		Acres		Value of products	
	Number	Per cent of all farms	1909	1899	1909	1899
Vegetables, other than potatoes and sweet potatoes and yams, total	[1] 4,271	38.9	2,933	1,431	$332,120	$87,882
Farms reporting a product of $500 or over	65	0.6	228	....	51,687	....
All other farms	4,206	38.3	2,705	......	280,433	....
Flowers and plants, total	5	(2)	6	5	12,280	2,480
Farms reporting a product of $250 or over	3	(2)	....	.....	12,020	
All other farms	2	(2)	....	.....	260	....
Nursery products, total	8	0.1	(3)	2	1,680	215
Farms reporting a product of $250 or over	..	......	......	.....	......	....
All other farms	8	0.1	(3)	......	1,680	....

[1] Does not include 1,503 farms which reported that they had vegetable gardens, but gave no information as to their products.
[2] Less than one-tenth of 1 per cent.
[3] Reported in small fractions.

In 1909 the total acreage of potatoes and other vegetables was 11,266 and their value $856,639. Excluding (so far as reported separately*) potatoes and sweet potatoes and yams, the acreage of vegetables was 2,933 and their value $332,000, the acreage being more than twice and the value nearly four times as great as in 1899.

The raising of flowers and plants and of nursery products was unimportant in Wyoming.

Small fruits: 1909 and 1899. The following table shows data with regard to small fruits on farms:

CROP	Number of farms reporting 1909	Acres		Quantity (quarts) 1909	Value 1909
		1909	1899		
Small Fruits, total	....	106	37	96,883	$13,984
Strawberries	146	24	19	20,895	3,820
Blackberries and dewberries	6	(1)	(1)	149	29
Raspberries and loganberries	80	14	6	15,213	2,910
Currants	303	41	8	38,833	4,378
Gooseberries	234	27	3	21,513	2,819
Other berries	3	(1)	1	280	28

[1] Reported in small fractions.

The total production of all small fruits in Wyoming in 1909 was 96,883 quarts and in 1899, 37,330 quarts, and the value was $13,984 in 1909, as compared with $4,964 in 1899. The most important of the small fruits in 1909 were currants.

Orchard fruits, grapes and nuts: 1909 and 1899. The following table presents data with regard to orchard fruits, grapes and nuts. The acreage devoted to these products was not ascertained. In comparing one year with the other the number of trees or vines of bearing age is on the whole a better index of the general changes or tendencies than the quantity of product, but the data for the censuses of 1910 and 1900 are not closely comparable, and the product is therefore compared, although variations may be due largely to temporarily favorable or unfavorable climatic conditions.

* It is probable that some of the potatoes and sweet potatoes and yams raised in farm gardens were not reported separately by farmers, but were included in their returns for vegetables.

CROP	Trees or Vines of bearing age 1910		Trees or Vines not of bearing age 1910		Product		
					1909		1899
	Farms reporting	Number	Farms reporting	Number	Quantity[1]	Value	Quantity[1]
Orchard Fruits, total	....	33,497	....	97,013	18,586	$39,774	1,145
Apples	737	27,773	1,175	84,024	17,836	37,580	989
Peaches and nectarines	6	46	71	419	5	30	....
Pears	51	178	155	901	16	65	3
Plums and prunes	219	4,564	456	7,475	659	1,842	7
Cherries	135	919	441	4,025	68	251	1
Apricots	5	17	31	121	2	6	....
Quinces	....	....	8	40	....	....	(2)
Mulberries	....	....	1	8	....	....	(2)
Unclassified	....	....	....	....	....	....	[3] 145
Grapes	12	74	88	1,147	159	32	1,200
Nuts	....	[4] 18	....	[4] 12	....	....	....

[1] Expressed in bushels for orchard fruits, and pounds for grapes.
[2] Included with "unclassified."
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."
[4] Includes Persian or English walnuts, black walnuts and other nuts.
[3] Consists of products not separately named by the enumerator, but grouped under the designation "all other."

The total quantity of orchard fruits produced in 1909 was 18,586 bushels, valued at $39,774, apples contributing about 96 per cent of this quantity. The production of grapes in this state is unimportant.

The following table shows the quantities of the more advanced products manufactured by farmers from orchard fruits and grapes. Values were not called for on the schedule:

PRODUCT	Farms reporting, 1909		Quantity produced		
	Number	Per cent of all farms	Unit	1909	1899
Cider	9	0.1	Gals	612	94
Vinegar	5	(1)	Gals	239	94
Wine and grape juice	5	(1)	Gals	197	....
Dried fruits	2	(1)	Lbs	110	....

[1] Less than one-tenth of 1 per cent.

YELLOW TRANSPARENT APPLE FOR MASSACHUSETTS. See *Massachusetts.*

YAKIMA VALLEY. See *Washington.*

YAKIMA VALLEY FRUIT GROWERS' ASSOCIATION. See *Marketing.*

YAM. See *Sweet Potato.*

Index

KEY

Type

Subject headings in the Index appear in alphabetical order in black capitals. These refer to main articles in the Encyclopedia, to paragraph headings, and in many cases to subjects treated without paragraph headings.

Scientific names are in small black-face type.

Subheadings and paragraphs under all headings are in light-face type, but subheadings are flush with the column while headings under subheadings use the indented paragraph. All numbers are in light-face type and refer to pages.

How Subjects Are Listed

It has been the aim to list in the Index all subjects of importance in two ways: First, they appear under their own heading in alphabetical order. Second, all large subjects, such as the different fruits and vegetables, have their related topics listed under them in alphabetical order in the form of subheadings and paragraphs under subheadings.

For example: **APPLE** 56-552
Orchard 85-326
Cover crops 236-55, etc., etc.

This means that the whole subject of Apple is to be found between pages 56 and 552, that the Apple Orchard is treated on pages 85 to 326, and that the subject of Cover Crops for apple orchards is found on pages 236-55. **Cover Crops** is also found under C in the main index. Thus all subjects of importance in the Encyclopedia will be found in the Index either in black capitals or under a main or subtopic to which they are directly related.

Diseases and Pests are listed in two ways: First, under their own headings followed by the host plant, under which they are treated, in (). Second, under the host plant in light-face type in alphabetical order, under the subheading **Diseases** or **Pests.** Scientific names are given in connection with the Diseases and Pests where they occur separately.

Recipes are listed under Recipes and also under each fruit and vegetable.

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The

Encyclopedia of Practical Horticulture

Some Opinions

2000 Pages, Size 7"x10"

Upon careful examination, I find that these volumes are admirably adapted to the requirements of scientific as well as practical orchardists throughout the Northwest. To the orchardists, fruitgrowers and farmers who desire to improve their methods of orcharding, I recommend these volumes most highly.

Yours respectfully,

C. C. VINCENT.

(Horticulturist.)

Glad He Helped to Make It

OREGON AGRICULTURAL COLLEGE

School of Agriculture and Experiment Station, Corvallis

Mr. W. Worthington, 407 Miller Bldg., North Yakima, Wash.

My dear Mr. Worthington: I wish to thank you sincerely for the set of the Encyclopedia of Practical Horticulture which you so kindly sent me some time ago. * * * You seem to have gotten together a work which will be of great value to practical men. I am glad to have been of service in furnishing material for it. I wish that I might have had more time to devote to it.

Thanking you again, I am,

Yours very truly,

H. S. JACKSON.

(Botanist and Plant Pathologist.)

"Extremely Valuable Set of Books"

BETTER FRUIT

E. H. Shepard, Publisher

Hood River, Oregon

Encyclopedia of Horticulture, N. Yakima, Wash.

Gentlemen: Allow me to thank you most sincerely for this extremely valuable set of books.

"*A Publication Which Has Been Greatly Needed*"

UNIVERSITY OF CALIFORNIA

College of Agriculture, Agricultural Experiment Station, Berkeley

January 5, 1915.

Mr. W. Worthington, Associate Editor and Secretary, Encyclopedia of Horticulture, North Yakima, Wash.

Dear Sir: I wish to assure you of my very sincere appreciation of the Encyclopedia of Practical Horticulture which has just been received. It is a very creditable publication and one which I am sure will be of great value to the practical horticulturists throughout the west,—a publication which has been greatly needed.

Thanking you and trusting that if I can be of service you will call upon me, I am,

Yours very truly,

E. O. ESSIG

(Entomologist and formerly with the California State Commission of Horticulture.)

"*Recommended for Every Fruitgrower*"

OREGON AGRICULTURAL COLLEGE

School of Agriculture and Experiment Station, Corvallis

January 7, 1915.

Mr. W. Worthington, Encyclopedia of Horticulture Corporation, 407 Miller Bldg., North Yakima, Wash.

My dear Sir: Your recent letter received and also the copies of the Encyclopedia of Practical Horticulture. I was very glad to receive the same.

I am sure that every fruitgrower in the Pacific Northwest should have these volumes in his library. Not only the growers in the Northwest, but eastern growers who are ever seeking some of our western ideas, should find the volumes of great help to them in their orchard work.

They are well edited, printed on good paper, nicely illustrated, and seem to contain the pith of the subjects they handle. Not only have they dealt with the western experts, thus giving the books a decidedly Pacific Coast flavor, but they have sufficient amount of material from the horticulturists of the Middle West and East to make the books broad in their scope.

I shall take great pleasure in recommending to the fruitgrowers in general that they examine these books and add them to their libraries.

Another year in our library budget, I shall include this Encyclopedia on our list, so it will be placed on our shelves where it will be accessible to the students of horticulture.

I am very glad that we have a work of this kind in the Pacific Northwest. We have needed something for a long time, which took up this work more from the standpoint of western conditions.

With very kind regards I remain,

Sincerely yours,

C. I. LEWIS.

(Chief, Division of Horticulture.)

"*Admirably Adapted to Scientific as Well as Practical Orchardists*"

UNIVERSITY OF IDAHO

College of Agriculture and Agricultural Experiment Station, Moscow, Idaho

January 15, 1915.

Mr. W. Worthington, North Yakima, Wash.

Dear Sir: Upon my return to this office, I find your letter of December 31st, also a copy of the Encyclopedia of Practical Horticulture. I wish to say that I have been looking forward with a great deal of pleasure for the appearance of the Encyclopedia of Horticulture. The need of such a work, covering the various fields of practical horticulture, is apparent.

W. M. FLEMING, PRESIDENT | DR. GRANVILLE LOWTHER, EDITOR-IN-CHIEF | WM. WORTHINGTON, ASSOCIATE EDITOR AND SECRETARY

ENCYCLOPEDIA OF HORTICULTURE
CORPORATION

407 MILLER BUILDING

NORTH YAKIMA, WASHINGTON Feb 8 '15

Librarian Mass. Agri. Coll.
Amherst, Mass.

Dear Sir :

We are sending by prepaid express to day per order of G.E.Stechert & Co. New York, one set of the Encyclopedia of Practical Horticulture in three volumes. The list price of these books is $20.

We trust that they will be received in good condition. These books are finding their way into a good many schools in the west and seem to be giving satisfaction.

Thanking you for the order, we are

Your's truly,
ENCYCLOPEDIA OF HORTICULTURE CORPORATION
W Worthington

Well done! Ham

THE SEATTLE DAILY TIMES, MONDAY EVENING, OCT. 19, 1914.

instance, it will be simply because the American people have more sound common sense than the legislator from Massachusetts.

A NEW BOOK FOR FRUIT MEN.

ONE OF THE MOST VALUABLE as well as the most ambitious works to come from local press is "The Encyclopedia of Practical Horticulture," with Granville Lowther as editor-in-chief and William Worthington as associate editor.

The first of three elaborate volumes has just been issued by Lowman & Hanford, Seattle, under the authority of the Encyclopedia of Horticulture Corporation, of which W. M. Fleming is president.

The work is a reference system of commercial horticulture. It presents an undertaking never before attempted —that of covering the practical and scientific phases of horticulture with special reference to fruits and vegetables.

Its value rests on the fact that the Pacific Northwest has been made the field of research, and that the editors have been assisted by the best known scientific and practical horticulturists. The preface to the first volume sets forth six salient points:

1. We are living in the midst of one of the best fruit districts of the world, and have learned from practical experience what the fruit grower needs.
2. Our fruits, especially our apples, command the highest prices in the markets of the world.
3. The editors have visited all the principal fruit-growing sections of the United States and parts of Canada.
4. They have consulted many of the most prominent horticulturists, and have obtained information from all available sources.
5. They have consulted the literature that has seemed best adapted to their needs, and have quoted from able writers, giving to each and every one due credit.
6. They have embodied articles from the ablest contributors and specialists; have tried to bring everything up to date, and to condense into three volumes that which they believe is of the most practical value to the fruit grower.

The work becomes more valuable, when it is remembered that the editors have not tried to be technical and yet have aimed to make all of their teachings conform to the facts as scientists have discovered them.

The plan is to set forth in their natural order all the steps and processes for the propagation, maturing in their highest perfection, harvesting and marketing of all the commercial fruits and vegetables.

All the information necessary for the selection of proper seeds or stocks, site, soil and climate, the kind of preparation to make and care to give, the sort of cultivation, fertilization and pest prevention to provide for and costs of production, is given.

All processes set forth in the three volumes are illustrated with 750 drawings and photographs.

The "Encyclopedia" therefore represents an outlay of many thousands of dollars. It is a work of highest excellence, meriting generous support from the people of Washington and the Pacific Northwest, the resources of which region it portrays in a most thorough and attractive manner.

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